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Montana Renewable Energy Grants Program

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Montana Renewable Energy Grants Program

abstracts

written by: R. Kitty Kvinge
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James Iversen
Gerhard Knudsen

ACKNOWLEDGEMENTS

The author wishes to gratefully acknowledge staff engineer James Iversen, Dana Gunderson and former bureau chief Gerhard Knudsen for their continuous assistance and support in preparing these project abstracts.

INTRODUCTION

This booklet contains abstracts of renewable energy projects funded by Montana's Alternative Renewable Energy Sources Program. Each has been drawn from the applicant's proposal and contains a description of the scope of work and the main purpose of the project. Interesting or innovative features have been included, as have details concerning the components of an individual system where needed to clarify the scope of the project. In some cases, details were not provided by the applicant since they would not be known until the project was underway.

These abstracts are meant to inform the reader about what has already been attempted through the program, and where the projects are located. They may also serve to spur innovative spinoffs of the work that is currently being conducted. For further information about the program, contact:

Alternative Renewable Energy Sources Program
Renewable Energy Bureau
Department of Natural Resources and Conservation
32 South Ewing
Helena, Montana 59601
(406) 449-4624

MONTANA ALTERNATIVE RENEWABLE ENERGY SOURCES PROGRAM

The Alternative Renewable Energy Sources Program was authorized by the Montana Legislature in 1975 through Senate Bill 86 (90-4-101 through 90-4-107, MCA, formerly Sections 84-7407 through 84-7412, R.C.M. 1947). The purpose of the act is to assist the state with lessening reliance on conventional energy sources and enhance ecological stability by stimulating research, development and demonstration of renewable energy sources. The act also provides funding for such work. The program is administered by the Energy Division of the Department of Natural Resources and Conservation and grants are awarded for projects which research, develop or demonstrate such renewable energy sources as solar, wind, geothermal, water and biomass. Yearly funding for the program is derived from 1.88 percent of the state coal severance tax through 1979; thereafter, the amount available will be 2.5 percent. The Department will grant funding for projects conducted in Montana and applicable to this state's energy needs; grants are given for a period of one year. All information relating to the projects is made available to the public.

SPECIAL NOTE: The amount of the grant award for each project does not necessarily reflect the total cost; it has been provided to show the amount of funding support.

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BIOMASS

CONVERSION

RAE 486-ROBBINS-761 — **Biological, Biochemical and Chemical Engineering Techniques for Using Biomass as Energy Source**

Grantee: **John Robbins**
Chemistry Department
Montana State University
Bozeman, MT 59717

Grant Amount: $19,480

Award date: 12-8-76

ABSTRACT:

Laboratory experiments will be conducted using municipal sewage, municipal garbage, straw from cereal grains, animal waste and forest products waste in order to determine the best use of an anaerobic digestion method for changing these products to fuel and fertilizer. The grantee will use different ratios and combinations of the waste materials to produce feed stock of varying nitrogen and fermentable carbohydrate content which will help determine the best carbon-nitrogen ratio for the production of methane.

RAE 401-ROBBINS-772 — **Bioconversion of Wastes: An Attempt to Increase Efficiency**

Grantee: **John Robbins**
Chemistry Department
Montana State University
Bozeman, Montana 59717

Grant Amount: $32,637

Award date: 1-4-78

ABSTRACT:

The grantee will continue the work begun under RAE 486-ROBBINS-761 with additional laboratory equipment to expand the number of tests and conduct them simultaneously. The focus of the experiments will be to examine how the anaerobic digestion process might be influenced in order to reduce the amount of time needed to convert the waste products to methane and an attempt will be made to increase the number of useful products derived from the process.

RAE 402-WARD-772 — **Survey of Biological Methane Production from Agricultural, Domestic and Industrial Sources**

Grantee: **David Ward**
Microbiology Department
Montana State University
Bozeman, Montana 59717

Grant Amount: $23,910

Award date: 1-9-78

ABSTRACT:

The biological reactions and processes which occur in converting cattle manure, wheat straw, domestic sewage and organic materials into methane, will be studied to determine how the reactions limit the rate of methane production. His experiments will establish the normal conditions of methane production for all four wastes and from there, determine whether the conversion can be biologically influenced to increase the rate of production. If the conversion can be accelerated, the grantee will determine to what extent while maintaining a stable reaction.

RAE 700-BRELS-772 — **Feasibility Study of Producing Energy from Crops and Crop Residues**

Grantee: **Don Brelsford**
Brelsford Engineering
P.O. Box 1252
Bozeman, MT 59715

Grant Amount: $25,000

Award date: 8-24-78

ABSTRACT:

This study will be a three-phase review at progressively greater levels of detail into existing, evolving and potential applications of technology used in the conversion of agricultural biomass to fuels. In this study, agricultural biomass materials will be all of those except forest products or by-products, water-based crops and animal wastes.

In the first phase, all biomass processes and approaches which offer potential for application in Montana will be inventoried. From these, the grantee will choose those that show the most promise for economical development and conduct a more detailed investigation involving a thorough search of literature relating to the technologies and approaches and direct communication with persons who are researching or applying the technology. The final

result will be recommendations to the Department to either conduct additional research based on the existing information, perform engineering design studies, begin construction of a bench, pilot or commercial-site plant, or make suggestions for economic, environmental or other studies.

RAE 412-MCBD-781 — **Biogas Feasibility Study for Montana**

Grantee: **National Center for Appropriate Technology**
John McBride, Technical Director
P.O. Box 3838
Butte, Montana 59701

Grant Amount: $25,624

Award date: 7-1-78

ABSTRACT:

An evaluation of biogas generation from agricultural waste that specifically relates to the climate and type of agricultural operations currently practiced in Montana will be performed to assess existing technology and hardware, possible sites for a demonstration plant, and prepare a preliminary design for a specific demonstration facility. Commercially offered systems, custom engineered systems already installed, and modeled systems will be assessed with emphasis on systems that can be adapted to colder climates and the agricultural wastes available in Montana. The preliminary work on the facility design will include sizing and specifying the main hardware components for a complete biogas system at one of the selected locations. The design will allow flexibility within the facility for adding and restructuring components as new research data are obtained.

RAE 303-MERDI-782 — **Feasibility Study For a Straw Burning Central Heating Plant**

Grantee: **Ed O'Hair/Charles Green**
MERDI
P.O. Box 3809
Butte, MT 59701

Grant Amount: $38,736

Award Date: 9-14-79

ABSTRACT:

A statewide assessment will be made on farm straw residues which are suitable for direct combustion. The assessment will investigate the best time and collection devices for the residues, the packaging and storage requirements and the processing required for combustion. If proven to be energy efficient, the feasibility of establishing a community based straw burning unit will be explored.

COMBUSTION (wood)

RAE 340-ZYCHEK-761 — **Wood Fireplace with Water Coils for Space Heating of Home Using Water Heat**

Grantee: **Robert Zychek**
Route 1, Box 89A
Bozeman, MT 59715

Grant Amount: $1,000

Award date: 5-1-77

ABSTRACT:

A fireplace will be adapted to provide additional space heating for a single family dwelling that uses a hot water home heating system by adding an outside forced-air damper, glass doors, and a black iron pipe firegrate. Water will circulate through the firegrate and be piped into the home's hot water radiator system via a pump and control valves. When the fireplace is being used, water will circulate through this system and evenly distribute the heat throughout the home. When a fire is not burning, water will be heated by a conventional oil-fired boiler. Care will be taken to develop a system with a simple design and one that is within the economic reach of the average Montana homeowner.

RAE 374-HAGAN-761 — **High Efficiency Wood Furnace With Water Storage for Space Heating of Home**

Grantee: **S. Richard Hagan**
Industrial Engineering Department
Montana State University
Bozeman, MT 59717

Grant Amount: $4,000

Award date: 12-15-76

ABSTRACT:

A home built wood furnace having a 15.8 cubic foot firebox that is completely surrounded by a water jacket to extract heat will be built to heat a home. A row of water jacketed fire tubes will be mounted horizontally above the firebox to increase the efficiency by capturing heat from the flue gases as they pass through to the chimney. Two, 3-inch pipes will connect the boiler to a 1,504 gallon storage tank and the water will circulate by thermosiphon through the boiler-storage loop. The hot water in the storage tank will be pumped through conventional fin-tube radiators suspended above the insulation between the floor joists which should force most of the heat up through the floor of the home. The system is expected to provide over 30 percent of the space heating needs. The home has electric baseboard heaters for backup heating.

RAE 132-DRSCL-771 — **Hippert Furnaces and Solar Air Collectors for Boy's Home**

Grantee: **Denny Driscoll Boy's Home**
Reverend J.F. Finnegan
P.O. Box 3093
Butte, MT 59701

Grant Amount: $30,000

Award date: 9-21-77

ABSTRACT:

Two projects, one using wood energy and one using solar, will supply heat to the 5,000 square-foot Denny Driscoll Boy's Home. A wood burning furnace will be installed in the basement and used to heat the main living quarters. A second wood-burning furnace will be installed adjacent to the home's sunroom to heat it and possibly the adjacent rooms. Insulated shutters will be installed on the sunroom's extensive single-paned windows to maintain heat from the wood furnace and allow the room to function to a limited extent as a passive solar collector.

A solar air collector, located outside near the home, will be used to heat water which will be stored in a 2,000 gallon underground tank and eventually pumped through baseboard radiators for space heating. The gas boiler will be used for backup to the solar system. The grantee expects to receive close to 100 percent of the heat requirements with the two systems.

RAE-301-IPD-771 — **Automatic High-Efficiency Wood Furnace**

Grantee: **Bill Delp**
Independent Power Developers
Box 1467
Noxon, MT 59853

Grant Amount: $6,968

Award date: 7-20-77

ABSTRACT:

A wood burning furnace designed to accept logs 12 inches in diameter and 8 feet long will be installed in a rectangular pit five feet below grade and used to heat a 2,560 square foot shop building. Damper control will be automatically regulated and an air-tight lid and small air intake valve will allow the fuel to burn in a cigar-like manner, preventing runaway combustion and providing steady even heat. The grantee hopes that this furnace design will be able to equal or surpass the combustion efficiency of any wood burner currently being produced.

RAE 303-FISCUS-771 — **Increase Efficiency and Monitor Wood Fireplace for Supplementary Home Heating**

Grantee: **Alvin Fiscus**
Route 3, Box 60
Bozeman, MT 59715

Grant Amount: $600

Award date: 7-29-77

ABSTRACT:

The grantee will attempt to make an existing fireplace more efficient by using a cast iron steam radiator in the fireplace box that will have water circulating through it and be connected to the home's hot water space heating system.

The system will be evaluated by comparing how fast it can heat the home to how fast the gas boiler system can, and by comparing the volume of natural gas used during the weekends of October through March from the past two years to the amount used during the test period.

RAE 304-SMITH-771 — **Automatic Wood Furnace and Fireplaces for Heating System**

Grantee: **Leland Smith**
2425 Chaparral Road
Helena, MT 59601

Grant Amount: $2,837

Award date: 7-11-77

ABSTRACT:

An automatic wood furnace and two fireplaces equipped with heatilators, double-walled air jackets with convection heat vents and glass doors will be used to heat a 3-bedroom, single-story home. The automatic draft control incorporated in the wood furnace is activated by temperature; keeping the fire at a steady burning rate to provide a longer and even source of heat. The two fireplaces will be expected to provide most of the home's heat during the day. A combination wood and electric stove will be used for cooking.

RAE 311-MASN-781 — **Hippert Wood Furnace for Space Heating**

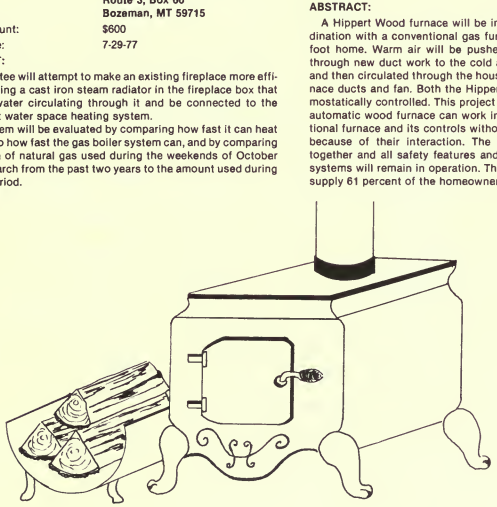
Grantee: **John Mason**
Blue Sky Heights
Clancy, MT 59634

Grant Amount: $510

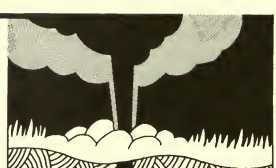
Award date: 10-16-78

ABSTRACT:

A Hippert Wood furnace will be installed and operate in coordination with a conventional gas furnace to heat a 1,400 square foot home. Warm air will be pushed from the Hippert furnace through new duct work to the cold air return of the gas furnace and then circulated through the house using the existing gas furnace ducts and fan. Both the Hippert and gas furnaces are thermostatically controlled. This project will be to assess whether an automatic wood furnace can work in conjunction with a conventional furnace and its controls without causing control problems because of their interaction. The systems will be connected together and all safety features and functioning modes of both systems will remain in operation. The new system is expected to supply 61 percent of the homeowners total heating.



GEOTHERMAL



RAE 559-SPILKER-761 — **Geothermal Energy for Subdivision**

Grantee: **William Spilker**
Box 244
Helena, MT 59601

Grant Amount: $15,000

Award date: 3-16-77

ABSTRACT:

A single-family residence will be constructed and designed for a complete geothermal heating system using the naturally occurring Broadwater Hot Springs. The heating system will involve drilling a well, installing a heat exchanger within the well, placing distribution piping to the dwelling and installing a pump to circulate the hot water in a closed system. The hot water will flow through a hot water coil and air handling unit in a furnace for space heating and pass through a heat exchanger tank to heat domestic hot water. The temperature in the dwelling will be controlled by a room thermostat which starts and stops the fan in the furnace unit. If desired, hand valves could be used to turn the water off in the summer, or automatic valves could be added. The system is expected to supply all the space heating requirements and an electric hot water heater will provide backup heating for domestic hot water. The house will be used for demonstration and testing and as a possible model for a future subdivision the grantee has planned in the area.

RAE 503-GROVE-771 — **Geothermally Heated Bank in White Sulphur Springs**

Grantee: **Michael Grove, President**
First National Bank
White Sulphur Springs, MT 59645

Grant Amount: $43,500

Award date: 7-11-77

ABSTRACT:

A geothermal heat source will be used to provide space heating for a new bank building in White Sulphur Springs. A well will be drilled 1,000 feet deep; a 30-foot conductor pipe will be cemented in and flanged gate valves and other fittings will prevent blow-out if high artesian pressure is encountered. Detailed temperature and strata profile logs taken during drilling will help determine the geothermal potential and pump tests will be used to estimate available flow rates. The system will use heat exchangers to transfer heat from the geothermal water to the air heating system of the building. A re-injection dry well of 400 feet will be used to dispose of the geothermal water.

RAE 505-HARMN-771 — **Geothermal Spring for Heat Pump System as Home and Greenhouse Heating**

Grantee: **Dave Harriman**
Post Creek
St. Ignatius, MT 59865

Grant Amount: $4,000

Award date: 7-11-77

ABSTRACT:

A geothermal spring will be used by a heat pump system and a solar greenhouse to provide space heating for the home and heat and humidity for the greenhouse. Because the heat pump, located inside the home, will be using constant temperature water rather than outdoor air, performance and output is expected to be about four times as efficient as standard electric heating. The warm water will be used for heating the 384 square foot greenhouse by pumping it through a serpentine pattern of four inch pipe buried in the floor. For humidity and freeze protection, a "curtain" of the warm water will be sprayed from holes in a half-inch pipe suspended five feet above floor level and fall into a large water through at ground level. Used in conjunction with solar energy, this system should allow the greenhouse to operate year-round.

RESEARCH AND DEVELOPMENT

RAE 504-BRCLY-771 — **Conceptual Design for Geothermal Energy Use at Warm Springs State Hospital**

Grantee: **Karen Barclay**
Montana Energy & MHD Research and Development Institute
P.O. Box 3809
Butte, MT 59701

Grant Amount: $9,000

Award date: 7-11-77

ABSTRACT:

A conceptual design study will determine the energy demand of Warm Springs State Hospital and explore the feasibility of using the natural hot springs to satisfy the demand. An energy audit will determine where and how much energy the hospital uses. Methods of energy use reduction will be explored and implementation costs estimated. A recommendation for the most promising development of the geothermal source and its cost will be given, along with an estimate of operating costs reduction if the geothermal source is put to use.

As a secondary objective, the grantee will seek additional funding to demonstrate geothermal space heating at the Warm Springs Hospital complex based upon projected results of the resource exploration study being conducted under RAE 515-WDMN-781.

RAE 501-BARTS-772 — **Test for Geothermal Potential**

Grantee: **John Bartos**
Mountain View Memorial Hospital
Box Q
White Sulphur Springs, MT 59645

Grant Amount: $2,000

Award date: 3-8-78

ABSTRACT:

A test well 220 feet deep will be drilled to analyze the mineral content, the temperature, and the flow rate of the geothermal water and to study the feasibility of using it for heating the Mountain View Memorial Hospital. Data gathered from this project will be used in conjunction with data from another geothermal test well being drilled 150 yards away (see RAE 503-GROVE-771) along the same fault line to help assess the geothermal potential in the White Sulphur Springs area.

RAE 515-WDMN-781 — **Geothermal Development for Warm Springs Area**

Grantee: **Montana College of Mineral Science and Technology**
C. Wideman, Associate Professor
Butte, MT 59701

Grant Amount: $10,265

Award date: 7-31-78

ABSTRACT:

This grant will be for an interpretative study to provide detailed data concerning the extent of the geothermal resource near the Warm Springs State Hospital and will include a survey for location of a test well site. Previous work conducted under RAE 504-BRCLT-771 has determined that the geothermal source at Warm Springs State Hospital is of an artesian nature, and its flow and temperature at the surface was found to be within the range needed for space heating or similar application. This study will expand on those findings to determine the extent of the geothermal resource in the area and provide information for the location of a test well site.

RAE 500-PAGE-782 — **Geothermal Feasibility Study**

Grantee: **Charles Page**
Route 4, Box 142
Bozeman, MT 59715

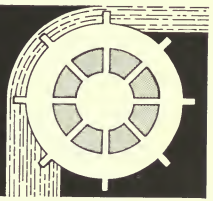
Grant Amount: $15,000

Award date: 7-17-79

ABSTRACT:

A 1,000 foot test well will be drilled through sediments beneath the Bozeman Hot Springs to assess the quantity, temperature and chemical quality of the water. Three wells exist at the site; two that are 66 feet deep and one that is 457 feet deep. At present, the maximum well temperature has been found to be 59.5°C (139°F) at a 127-130 foot depth. The goal is to drill into the bedrock estimated to be between 700-900 feet below the surface to locate the shear or fracture where the geothermal water originates and determine its potential for use.

SMALL-SCALE HYDRO



RAE 653-DELP-761 — **High Head Hydro-Electric Generation**

Grantee: **Bill Delp**
Independent Power Developers
Box 1467
Noxon, MT 59853

Grant Amount: $19,885

Award date: 11-12-76

ABSTRACT:

Three high-head, 6-kilowatt hydroelectric systems would be demonstrated in different areas of Montana. Each system could be mass-produced and would be capable of providing up to 14,112 kilowatt hours of electricity per year. A 2½ inch pipe will be used to transport water from the stream to a small shed housing a generator, a battery bank, and a DC to AC inverter. This project will demonstrate the environmental and economic significance of small-scale hydroelectric power plants. The potential for development is extremely high considering the large number of small streams in the state having the required flow and drop for high-head hydroelectric generation using a small-scale system.

RAE 603-BLDLP-771 **Low Head, Low Impact Hydro**

Grantee: **Bill Delp**
Independent Power Developers
Box 1467
Noxon, MT 59853

Grant Amount: $25,000

Award date: 7-20-77

ABSTRACT:

Two low-head hydroelectric systems capable of producing 1,146 to 2,109 kilowatt hours per month with a six kilowatt maximum instantaneous output will be installed at two sites. Preliminary research indicates that the newly developed, fixed propeller type hydroturbines to be used by the grantee will allow hydroelectric generating systems where it has previously been restricted to heads of 50 feet or more. Electrical storage batteries will handle peak loads and will be charged by the hydro generator when its output is not being fully used, which will eliminate the need of a water reservoir and dam, thus minimizing environmental impact and installation costs. The electrical application of these units could include farms, ranches, parks, cabin sites, industrial outposts, or other remote locations where public electricity has not been available.

RAE 603-SAVGE-772 **12 Kw Hydroelectric System**

Grantee: **Terry Savage**
P.O. Box 26
Lolo, MT 59847

Grant Amount: $14,050

Award date: 2-23-78

ABSTRACT:

A small earth-filled dam will be rebuilt and the steel pipe of an abandoned irrigation system will be repaired in order to install a 12-kilowatt hydroelectric system which will supply 100 percent of the energy requirements for a modern, 2,044 square foot, all-electric subterranean home. The reservoir will be available at will without a battery backup. The home will be the first subterranean home in the United States using a completely independent energy source that has been supported by the Farmer's Home Administration.

RAE 600-KLICK-782 **5 Kw High-Head Hydroelectric System**

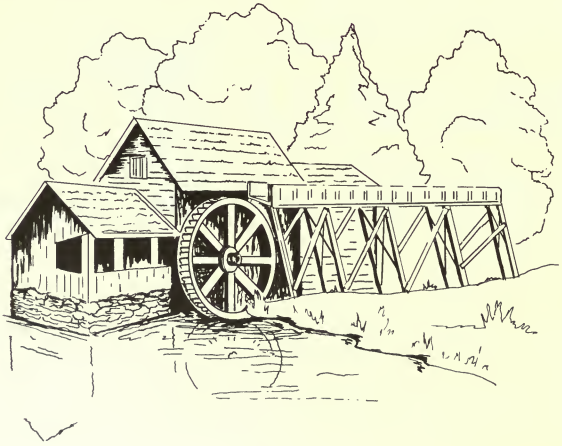
Grantee: **Richard Klick**
K Bar L Ranch
Box 287
Augusta, Montana 59410

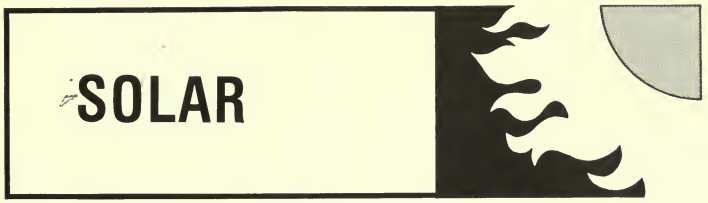
Grant Amount: $8,785

Award date: 4-19-79

ABSTRACT:

A 5 kilowatt D.C. generator unit will be installed to supply electricity for a summer recreational and fall outfitter's ranch that was previously using gas-powered generators. An 8-inch pipe will connect the unit to a 36,000 gallon holding pond, which will be constructed around an artesian well and used to provide storage for periods of peak electrical artesian well and used to provide storage for periods of peak electrical demand.





COLLECTORS

Liquid Flatplate

RAE 058-COONS-761 — **Solar Space & Hot Water Heating**

Grantee: **James Coons**
2401 Montana Avenue
3rd Floor, Rex Hotel
Billings, MT 59101

Grant Amount: $11,000

Award date: 11-12-76

ABSTRACT:

A 600 square foot double-glazed liquid solar collector will be part of the integral design of a new 2,945 square foot home. The active solar system will provide both space and domestic hot water by heating two, 1,000 gallon tanks of water. A duct heat exchanger will be use to transfer heat from the storage area to the forced air heating system. A heat pump will provide backup heat. The project should provide an example of solar architecture that is aesthetically pleasing and functional.

RAE 064-SHERIDAN-761 — **Adjustable Solar Collectors with Expandable Storage**

Grantee: **Richard Sheridan, Dale Horton**
Botany Department
University of Montana
Missoula, MT 59801

Grant Amount: $8,000

Award date: 11-12-76

ABSTRACT:

Liquid solar collectors that can be adjusted seasonally for maximum solar gain will be located 200 feet from the house and attached to an expandable storage system through insulated underground pipes for space heating. The 400 square feet of collectors will be connected to four water tanks consisting of two 500 gallon tanks and two 240 gallon tanks. These tanks will be connected in series to allow the storage size to be increased or decreased as the amount of available solar energy varies. Heat will be transferred from the storage tanks into the home through a liquid-to-air heat exchanger located in the return air duct of an oil-fired, forced air furnace. The grantee will also provide DNRC with a descriptive layman's handbook, types of materials, applicability, and costs for a solar system in western Montana.

RAE 109-OIEN-771 — **Solar Space & Hot Water Heating**

Grantee: **Orville Oien**
C-E Ranch, Inc.
R.R. 3, Box 89
Conrad, MT 59425

Grant Amount: $7,276

Award date: 7-13-77

ABSTRACT:

A roof-mounted shed will provide protection and a large reflective roof surface will help increase efficiency of a 96 square foot solar collector system which will be used for space and domestic hot water heating of a 1,550 square foot home. Water will circulate from the collector through copper tubing coiled inside 14 120-gallon storage tanks and the hot storage water will be pumped through the home's hot water radiators for space heating. The copper tubing will also be wrapped around the outside of a 40-gallon water tank for preheating domestic hot water. The oil-fired furnace will provide backup space heating and the electric hot water heater will provide backup hot water.

RAE 112-MCDND-771 — **Retrofit to Solar Space/Hot Water Heating for a House Using Hot Water Heat**

Grantee: **John MacDonald**
Route 1, Box 53C
Stevensville, MT 59870

Grant Amount: $4,314

Award date: 7-7-77

ABSTRACT:

A retrofit project consisting of 300 square feet of liquid flatplate collectors will heat and, during the summer, provide domestic hot water for a 3,000 square foot home. The collectors will be located on a slope 75 feet from the home and be connected to a heat-exchanger in the home via insulated copper tubing buried in a trench 18 inches deep. The heat exchanger will provide heat to either a 1,500 gallon tank for heat storage, a domestic hot water tank, or directly into the home heating loop which consists of floor coils and baseboard radiators. The solar system is expected to provide total heat to the home for all but 100 days of the year and reduce the amount of fuel required by the backup wood furnace during the rest of the time.

RAE 129-KRTGR-771 — **Solar Space and Hot Water Heating —Wood Assist**

Grantee: **Jack Kreitinger**
Route 1, Box 195
Three Forks, MT 59752

Grant Amount: $4,315

Award date: 7-11-77

ABSTRACT:

Solar heated water from a manufactured "A" shaped liquid solar collector unit located adjacent to the owner's greenhouse will be pumped through the greenhouse and the home's living room wall to provide radiant heat for both. The hot water will be stored in a 2,000 gallon tank and will preheat domestic hot water through a heat exchanger coil connected to a 52 gallon hot water heater. Four heating coils laced through the existing wood stove will also heat water for the storage tank. Electric baseboard heaters will supply back-up heating.

RAE 120-LOM-782 — **Solar Heated Insurance Building**

Grantee: **Life of Montana Insurance Co.**
Herbert Richards
28 N. Black Avenue
Bozeman, MT 59715

Grant Amount: $59,500

Award date: 6-19-79

ABSTRACT:

A 56,000 square foot insurance building will use 5,040 square feet of manufactured liquid flat plate collectors for space heating and domestic hot water preheating. The collector array will be located on the ground southwest of the building and an antifreeze solution will be pumped through a heat exchanger to a 10,000 gallon storage tank then out through heat exchangers into the building's forced air space heating system. A separate heat exchanger will be used in the storage tank for preheating domestic hot water. A natural gas boiler will provide backup heating.

RAE 122-BLGRD-782 — **Solar Heated School Building**

Grantee: **Belgrade School District #44**
P.O. Box 166
Belgrade, Montana 59714

Grant Amount: $91,360

Award date: 6-19-79

ABSTRACT:

This grant will support the third and final phase of a project to incorporate an active solar system at a new junior high school for supplemenal space heating. The structure will be made of 8 inch concrete blocks filled with polyurethane foam; be earth bermed where possible on all sides for insulation, and contain 2 by 6 inch interior wall construction with 6 inch fiberglass insulation to retain as much heat as possible from solar heating. The active solar system will contain 1,242 square feet of manufactured flat plate collectors which will be located on the roof and be aided by 12 foot reflective aluminum sheets. A 2,000 gallon storage tank will be located in the basement and the solar system will be connected from the tank to the building's hot water heating system with fan coil units. A separate heat exchanger coil will be used in the tank for preheating domestic hot water. The structure will also contain passive solar features of 365 square feet of glazing on the south and clerestory lighting in the halls, cafeteria and library. A natural gas boiler will provide backup heating.

Concentrating

RAE 159-KILBY-771 — **Solar Concentrating Collector System For Hot Water**

Grantee: **William Kilby**
3813 5th Avenue North
Great Falls, MT 59401

Grant Amount: $14,100

Award date: 7-11-77

ABSTRACT:

Commercial single-axis tracking collectors by photovoltaic cells will be incorporated into a hot water space heating system and also used to preheat domestic hot water. The collector system is designed to operate between 165° and 180°F and sized for a home temperature of 70°F when the outdoor temperature is -20°F. The solar heated water will pass through a tube-in-shell heat exchanger and either enter the storage tank or be routed through a jacketed preheating tank for domestic hot water heating. The storage tank is four, 250-gallon tanks that can be used one at a time to limit storage volume (and thereby increase temperatures) or used in parallel for larger quantities of storage. The water will flow through a series of fin-tubed baseboard units for space heating and can be drawn through the water jacket of the preheat tank to help heat domestic hot water. Operation of the pumps and valves can be manual or automatic. The home's water heater and electric boiler will be used for backup heat supply.

RAE 161-BRESE-771 — **Develop and Test 5 Tracking Parabolic Solar Collectors**

Grantee: **Ronald Breese**
P.O. Box 221
Whitefish, MT 59937

Grant Amount: $5,000

Award date: 7-15-77

ABSTRACT:

The project goal is to design, build, and test five tracking parabolic collectors in order to devise a unit that will be competitive with ordinary flat plate collectors. A variety of concentrating collector systems, designs, and tracking mechanisms will be explored and at least one of the concentrating collectors will have photovoltaic cells in the absorber position making it capable of producing limited electricty. From this work, the grantee expects to devise a prototype costing no more than a flat plate collector and to use it in a final system design, which is expected to have 10 to 15 concentrating collectors and expected to be capable of supplying sufficient space and hot water heating for a typical Montana home during most of the year.

Trickle

RAE 100-PALL-771 — **Solar Space and Hot Water Heating with Wood Assist**

Grantee: **Phillip Pallister**
Jaybird Ranch
Boulder, MT 59632

Grant Amount: $8,000

Award date: 7-20-77

ABSTRACT:

Trickle collectors and a double-walled steel jacket surrounding three sides of a fireplace will be used in an integrated system to supply heat and domestic hot water to a 4,300 square foot home. The main trickle collector will be mounted on the south wall of the

home; smaller trickle collectors will be mounted on the east and west walls to obtain some solar collection from the morning and evening sun. The collectors will be connected to a 2,500 gallon water tank located in the basement and the heated water will be routed through the radiant heating system for use.

Water will be circulated through the steel jacket surrounding the fireplace and heated, then pumped into the storage tank and used as the backup heat supply for the solar system.

The integrated system should insure the homeowner of hot water regardless of weather conditions and the three collectors should allow optimum use of the solar day without a tracking mechanism.

RAE 140-DILL-771 — **Solar Space Heating and Development of High-Efficiency Wood Stove**

Grantee: **Richard Dill**
Route 2, Box 50A
Stevensville, MT 59870

Grant Amount: $6,361

ABSTRACT:

An integrated system of solar, wind, and wood was designed to allow enough heat to be radiated or stored for space heating the dome house, the shop area, and the greenhouse, as well as provide domestic hot water. The components of the system consist of liquid solar collectors, water coils in the fireplace in the dome house, water coils in the owner-designed stove in the shop, and a resistance heater from a wind generator (not installed nor funded through this project). All of these systems lead to the 1,100 gallon storage tank located in the utility room. The idea is to store in the tank any excess heat from any source. This hot water is then used for domestic hot water, partially heating the dome, and heating the greenhouse. In addition, air collectors were installed along the south wall of the shop for space heating of that area.

The system uses 100 square feet of the trickle type collector. The wood stove incorporates directional baffles and a heat exchanger to heat the water coils along the side, which then leads the hot water to the storage tank.

RAE 128-TRCHT-771 — **Solar Hot Water —Trickle Collector**

Grantee: **Lawrence Truchot**
Route 2 South, Box 937
Great Falls, MT 59401

Grant Amount: $7,500

Award date: 7-20-77

ABSTRACT:

A 1,000 square foot trickle collector will provide warm water to a 3,500 gallon storage tank, and, by means of a refrigeration heat exchanger, heat air for a forced-air heating system in a two-story, three bedroom home. The system should provide 50 percent of the home's heat and the electric furnace will be used for backup heating

The Montana Power Company has agreed to install computer recording devices to monitor the amount of electricity used by the system's pump, the hot water heater and the electric backup heating systems, and to monitor the temperatures inside and outside the home.

RAE 139-JOHNSN-771 — **Solar Space and Hot Water —Trickle Collectors**

Grantee: **Otis Johnson**
Box 157
Turner, MT 59542

Grant Amount: $7,000

Award date: 7-11-77

ABSTRACT:

A home built solar trickle collector having 1,350 square feet will cover the entire south roof area of the house and attached garage and be used for space heating. Water will flow over the face of the collector and drain through pipes into a 576 cubic foot concrete storage tank located in the floor of the garage. When needed, the hot water will be pumped through a water-to-air heat exchanger and the furnace blower will move warmed air into the living quarters. Electricity for pumping the water will be provided by a wind generator not funded by the program. The grantee anticipates that the combined solar and wind system will provide 75 percent of the home's heating needs.

Air

RAE 009-TAYLOR-761 — **Solar Air Collectors, Wood and Heat Pump for Home Heating and Cooling**

Grantee: **James Taylor**
J.E. Taylor & Associates
2715 Airport Way
Helena, MT 59601

Grant Amount: $12,750

Award date: 11-12-76

ABSTRACT:

Two solar air collection systems, a fireplace, and a heat pump, will be combined into a complex system to heat and cool a 1,912-square-foot home and preheat domestic hot water. One of the solar systems will be a 234-square-foot vertical air collector array, built into the roof with its efficiency boosted by a reflective roof surface. The other solar system, a 192-square-foot vertical air collector mounted on the front of the garage, will include copper tubing filled with water and connected to a 200-gallon heat exchanger/storage tank for preheating domestic hot water. Hot air from both solar systems will be blown through ducting into a 425-cubic-foot rock storage bin and used for space heating. Hot air from the energy-efficient fireplace will also be blown into the rock storage area when needed. Home cooling will be provided by a heat pump unit that is connected directly to the rock storage area. The unit will use the house supply duct to route cooled air into the home.

RAE 019-OWEN-76 — **Solar Space Heating —Air Collectors**
Solar Water Preheating —Liquid Collectors

Grantee: **Gail Owen**
Route 1, Box 2247-A
Hamilton, MT 59840

Grant Amount: $12,262

Award date: 11-12-76

ABSTRACT:

A fully automated system using both air and liquid solar collection units will provide space and hot water heating for a 1,377-square-foot home. For space heating, a manufactured unit consisting of 96 square feet of air collectors with reflector panels, 12 tons of 1½-inch washed rock, and circulating fans will be

located beside the home and connected to the forced-air heating system will be a heat pump with a conventional electric heating unit. Domestic hot water will be preheated using 80 square feet of liquid solar collectors. The collectors will have stainless steel absorber plates and the unit will be built into the south wall of the house. Heat for domestic hot water will be stored in two well-insulated tanks, whose total capacity is 136 gallons. Backup heating for the liquid solar system will be a conventional electric hot water heater. This fully automated system will involve very complex electric switching circuitry to control the different modes of operation.

RAE 069-BOGGS-761 — **Solar Collector Systems for Low-Income Homes —Air Collectors**

Grantee: **Mike Barton**
District 11—Human Resources Council
307 East Main
Missoula, MT 59801

Grant Amount: $26,875

Award date: 1-5-77

ABSTRACT:

Solar air collector systems will be designed, constructed and installed in five low-income homes in Missoula as part of a solar technician training program. The key component for these systems will be a solar collector developed from a NASA design and the construction and installation of these low-cost systems will be done by Comprehensive Employment Training Act workers. The grantee intends to demonstrate that such a system could provide at least 40 percent of a home's heat requirement at a cost comparable with currently popular supplemental heating systems used in low-income homes. It is anticipated that these systems could be installed at about $8 per square foot. The final results of this project would not only provide examples of low-cost solar heating systems, but would also provide skilled labor experienced in the solar heating industry.

RAE 079-STOLTZ-761 — **Solar Space Heating —Air Collectors**

Grantee: **Mike Stoltz**
104 Juniper H.C.
Glendive, MT 59330

Grant Amount: $3,805

Award date: 12-17-76

ABSTRACT:

This project involves construction and demonstration of a solar heating system which has been employed in other areas of the United States in order to determine its usefulness and applicability in Montana. The project will consist of constructing a 400 square foot unit using discarded beer cans for the absorber surface, wood framing, and a vinyl or fiberglass covering. The collected hot air will be ducted directly into the house and the forced air furnace fan will be used to circulate it within the house. As better storage facilities are developed, one may be added to this system. Because of the simplicity of the design and the use of discarded materials, it is expected that a layman could build a similar solar collector system which could provide 30 percent of a home's heating needs for about $1,500 - $1,600. The backup heating for this home will be supplied by a gas-fired forced-air furnace.

RAE 090-LEVENGD-761 — **Solar Collector in Conjunction with Heat Pump for Home Heating**

Grantee: **David Leavengood**
Bridger Canyon, Rural Route 2
Bozeman, MT 59715

Grant Amount: $10,500

Award date: 11-22-76

ABSTRACT:

A solar hot air system coupled with rock storage and a heat pump will provide space heating for a home. The heat pump condenser unit will use the hot air generated by the solar system to maintain a high operating efficiency in heating the home. This type of solar system could be used to retrofit any home having a forced-air heating system, provided that exposure to the sun could be guaranteed. At this location, the small structure housing the collectors, storage, and heat pump condenser unit will be located adjacent to the home. The 200 square feet of collectors will be mounted at a 60 degree angle and coupled to 108 cubic feet of rock storage. An underground refrigerant line will connect the condenser unit to the compressor unit of the heat pump and to the forced-air heating system in the home.

RAE 101-HWRD-771 — **Solar Space Heating —Air Collectors**

Grantee: **Dennis Howard**
River Road
Glendive, MT 59330

Grant Amount: $6,000

Award date: 7-7-77

ABSTRACT:

A manufactured solar air collector unit consisting of five 4 foot by 8 foot collector panels with ground-level reflectors and a 15 cubic foot rock storage bin located immediately behind the collectors will provide heat to a 928 square foot home. Buried insulated ducts will bring warm air to the natural-gas furnace. A differential thermostat responding to temperatures in the collector, rock storage and home will control the blowers. The modular solar heating system, completely assembled and adjusted when purchased, will require only minor connections to ducts and wiring and should eliminate problems of installation.

RAE 120-ORVIS-771 — **Solar Mobile Home Heating —Air Collectors**

Grantee: **James Orvis**
Route 1, Box 347
Bozeman, MT 59715

Grant Amount: $3,700

Award date: 7-11-77

ABSTRACT:

A solar heated hot air system will be designed for mobile home use and consist of a large panel of black-painted aluminum covered with a single layer of Tedlar coated fiberglass and be positioned next to the south wall of a mobile home. The hot air will be brought into a 2.5 cubic yard rock and gravel heat storage bin located under the trailer and the home's blower and ducts will distribute heated air from the collector to storage and living space. Vents will be installed at the top of the collector to vent excess heat to the outside and the entire unit will be hand constructed. A recording thermograph will be used to evaluate the performance of this system.

RAE 124-PTRSN-771 — **Solar Home Space/Hot Water Heating with Attached Greenhouse —Air Collection**

Grantee: **Donald Peterson**
1 Carriage Way
Missoula, MT 59801

Grant Amount: $7,000

Award date: 7-20-77

ABSTRACT:

Solar heated air from a roof-mounted 672 square foot air collector will be pushed through a 20 ton rock storage bin located in the basement of a new, 2,480 square foot, two-story home and used for space heating. A greenhouse above the rock storage area will use any escaping heat.

A 32 square foot portion of the collector will preheat domestic hot water when the collector temperature exceeds 60 degrees Fahrenheit and heat in the rock storage area will be used for preheating at other times.

The backup system, a wood stove with a jacket around the firebox, will provide warm air to the rock storage via a thermostatically controlled damper. Insulation factors of R-20 in the walls and R-40 in the ceiling, triple-glazed windows and 2 by 6 inch construction will conserve energy loss from the home

RAE 138-CUNIF-771 — **Solar Space Heating with Wood Assist**

Grantee: **Gregory Cuniff**
742-33 "B" Avenue N.E.
Great Falls, MT 59404

Grant Amount: $16,850

Award date: 7-15-77

ABSTRACT:

Flat-plate air collectors coupled with a gravel storage tank and a fireplace modified with an air-to-air recovery system coupled to the storage tank will provide heat for the home. The home's natural gas furnace will satisfy additional heat demand when necessary.

The solar collectors, rock storage, and duct fans will be grouped together and enclosed in a structure separate from the house, making it a system that can be used by those who do not have enough room in the basement for rock storage and those who are not willing to alter the roof structure for collectors. However, there is some tradeoff in increased material costs and increased heat loss associated with this type of outdoor storage.

RAE 144-HUMRC-771 — **Low-Cost Solar Heating Systems for Mobile Homes**

Grantee: **Michael Barton**
District 11—Human Resources and Development Council
207 East Main
Missoula, MT 59801

Grant Amount: $26,000

Award date: 7-20-77

ABSTRACT:

Sixteen single-unit solar heating systems will be installed on mobile homes that consist of an air plate collector bank mounted in a vertical position to the south wall, an attached aluminum mylar reflector panel to reflect light into the vertical collector and a blower assembly installed beneath the reflector panel and connected to the system to circulate the air. No heat storage will be used for these single systems and the units will be designed for easy removal when the home is moved.

RAE 146-HRCOU-771 — **Solar Hot Air Collectors for 20 Low-Income Homes**

Grantee: **Dick King—Wayne Cross**
District 4 Human Resources Development Council
P.O. Box 1509
Havre, MT 59501

Grant Amount: $6,076

Award date: 7-11-77

ABSTRACT:

Low-cost solar air collectors will be designed and installed on approximately 20 low-income homes. Several designs, including active flat-plate air collectors which could be bolted onto a wall and passive window-box collectors, are expected to decrease natural gas use by as much as 30 percent.

RAE 162-ANDRS-771 — **Development of Semicircular Hot Air Solar Collector**

Grantee: **Lowell Anderson**
1311 University
Helena, MT 59601

Grant Amount: $4,000

Award date: 7-11-77

ABSTRACT:

A low-concentration hot-air solar collector will be developed using a semi-circular and corrugated reflective surface which will focus sunlight on thin-walled metal tubes suspended in each depression. This design should permit absorption of solar heat from a wide variety of angles and will not have a solar tracking mechanism. Air will be used instead of water as the transfer medium in order to reduce material costs and eliminate the clogging, freezing, and drain down problems associated with water systems.

RAE 029-LEIGH-772 — **Active Solar Space & Hot Water Heating—Air Collectors**

Grantee: **Max Leighty**
2212 Bullard Street
Miles City, MT 59301

Grant Amount: $3,245

Award date: 1-4-78

ABSTRACT:

This retrofit project is designed to show how an existing structure can be modified to accommodate a home-built active solar space heating and domestic hot water system. The project will consist of 270 square feet of homemade air collectors, mounted at a 60° angle on the south side of the home. The collectors will be made with rib aluminum panels, painted black and covered with double-pane glazing and include 4 inches of insulation as backing. Two motorized dampers, placed in the ducting near the entrance and exit points of the collector area, will be controlled by a differential thermostat connected in series with the fan that circulates air from the storage area to the collectors. The storage area, containing 400 cubic feet of washed rock, will be located beneath the southeast corner of the house. A used water tank will be installed in the rock storage area as a pre-heating device for domestic hot water.

RAE 040-ALEX-772 — **Solar Space Heating —Air Collectors Hot Water Preheat Tank and Wood Assist**

Grantee: **John Alexander, Box 426, McLeod Route, Big Timber, MT 59011**

Grant Amount: $10,972.45

Award date: 1-4-78

ABSTRACT:

An entire attic will be used as an active solar air collector by glazing of 480 square feet of exposed southern roof area. This system, designed by an MSU senior in architecture and as yet untried in Montana, will heat a new home. It will also preheat domestic hot water through installation of a preheating hot water tank in the collector area. The tank will be used as heat exchanger and for storage. Air heated in the attic will be blown into a rock storage area located in the basement. Although the solar system is expected to supply sufficient space heating, a Hippert wood furnace will also be installed in the area adjacent to the storage bin. Ducts leading into the storage bin and central heating system will allow the furnace to supply additional home heat when needed.

RAE 048-FWLKS-772 — **Solar System for Mobile Homes —Air Collectors**

Grantee: **Charless Fowlkes, 1820 South Seventh, Bozeman, MT 59715**

Grant Amount: $25,000

Award date: 7-5-78

ABSTRACT:

This project will be to construct and install a specially designed solar hot air heating system on a well-insulated mobile home. The system was designed by the grantee so that it could be incorporated during assembly-line production.

The south side of the mobile home will be covered with solar air collectors of sufficient size to supply complete space heating. A rock storage bin, located under the trailer pad, will be completed first; the home will be pulled over it and the necessary ducting will be connected. When it is moved, the complete solar collector system and duct work will remain with the trailer, and the rock storage will then be available for hook-up and use by the next mobile home.

All components designed for this system will be monitored and analyzed. The evaluation of this project will produce a marketing design for this solar heating system that can be built into a mobile home during its manufacture. Since well over 50 percent of the new homes bought in Montana are mobile, the potential impact on energy consumption in the area is tremendous. The system plan, performance, and cost information will be included in the final report.

RAE 065-SHMTZ-772 — **Solar Space Heating for Carpenter's Shop—Air Collectors with Wood Assist**

Grantee: **Phillip Schmitz, Ronan, MT 59864**

Grant Amount: $4,649

Award date: 4-24-78

ABSTRACT:

A home-built, 480-square-foot air solar collector system with rock storage will be designed and built to heat a carpenter shop. A wood-burning stove will also be modified to allow its heat to be routed into the storage area. The intent is to determine what percentage of the total heating demand will be provided by solar energy in a limited-use situation typical of most all commercial and industrial buildings.

RAE 026-GOHN-781 — **Solar Space Heating —Air Collectors**

Grantee: **Stephen & Gail Goheen, Route 2, Box 2578, Hamilton, MT 59840**

Grant Amount: $5,680

Award date: 7-27-78

ABSTRACT:

Both active and passive solar systems will be used for space heating a new 3-bedroom stucco home consisting of 1,850 square feet. Active solar heating will be provided by 600 square feet of homemade air collectors, situated below a deck in the front of the house. The heat storage will be an insulated bin in the basement containing 48 cubic yards of washed one and one-half inch rock. Air will be circulated within the house and from the rock storage by a conventional, central hot-air furnace, which will also provide backup heat when needed. A separate fan and motor-operated damper, controlled by a differential thermostat, will circulate air from the collector to storage.

The active system is designed to provide approximately 50 percent of the space heating requirements at an inexpensive system cost of $7.20 per square foot of collector. The house will also receive passive solar heating through 156 square feet of south-facing windows, which will be manually covered with insulating shutters at night.

RAE 029-ALMR-781 — **Solar Space and Hot Water Heating —Air Collectors**

Grantee: **John Allemeier, Simpson Route, Havre, MT 59501**

Grant Amount: $6,039

Award date: 9-11-78

ABSTRACT:

This project consists of building a 360-square-foot air solar collector of the grantee's own design and using it to heat his 960-square-foot home. The collector will have scattered metal filings on the absorber surface in order to decrease the amount of reflection and increase air turbulence. The absorber surface will be painted black and coupled with the rough surface, it is expected to decrease the amount of reflection that has been experienced with flat absorbers and should result in increased collector efficiency. The solar collector will be mounted on the south facing wall of the garage and a 13½-yard rock storage bin will be housed beneath the floor of the garage. A water tank placed in the rock storage area will preheat domestic hot water. An additional 13½-yard rock storage bin will be built under the garage and be used to bring cool air into the home for summertime air conditioning. Temperatures from the collector and the water preheater will continue to be monitored after final construction.

HYBRID/PASSIVE SYSTEMS

RAE 041-FISHER-761

Retrofit Solar Projects
—Solar Greenhouse
—Active Hot Water Heating System for Cabin
—Drum Wall for Space Heating of Cabin Solar Shower/Laundry Facility

Grantee: **John Fisher**
Jocko Hollow Alternative Energy Effort
Arlee, MT 59821

Grant Amount: $20,000

Award date: 11-22-76

ABSTRACT:

Four different applications of solar energy will serve as working models for the public to view and use at the Jocko Hollow campground and each will be a retrofit demonstration for an existing structure.

A 220 square foot passive solar greenhouse will be attached to the main home which will have 78 square feet of double glazing on the south and a set of insulating shutters to minimize heat loss at night.

One of the cabins will have a 14 foot by 16 foot greenhouse addition containing 150 square feet of glazing and an 84 square foot active solar air collector array coupled to 130 cubic feet of rock storage. Insulated reflective shutters will minimize heat loss at night. A fireplace will also be built into the rock storage area to provide backup heating. The cabin's domestic hot water will be preheated by 64 square feet of double glazed active liquid collectors located on the roof, which will heat water for a 30 gallon preheat tank

A second cabin will have a 20 foot by 6 foot extension with 42 square feet of double glazing on the south and nine, 40-gallon water filled barrels located behind the glazing to act as heat storage. This passive solar system will also have reflective shutters to aid solar gain and minimize heat loss at night. Finally, a 126 square foot active liquid solar collector will be built onto the roof of the showerhouse/laundry facility for preheating domestic hot water. The preheating system will heat 340 gallons of water stored in a large fiberglass tank, which can be used for preheating the showerhouse/laundry facility water or, as a secondary use, for additional space heating and domestic hot water preheating in the second cabin.

The grantee will use the information and experience gained from these projects to establish a public resource library and clearinghouse for renewable energy interests in the western Montana area.

RAE 045-FOWLKES-761

Passive Solar Home With High-Efficiency Wood Furnace

Grantee: **Cherless Fowlkes**
31 Gardner Park Drive
Bozeman, MT 59715

Grant Amount: $10,000

Award date: 11-12-76

ABSTRACT:

A passive solar heated home will be built in Bozeman, which will use a large tube wall as the main source of space heating and a wood furnace for the backup heating system. Active solar heating of the service water will also be included in the structure (but not part of the project).

The philosophy of the entire design has been to make the house and the energy systems as simple as possible. The Trombe wall concept was used for designing the tube wall, which will consist of 20 fiberglass tubes, each holding 1,500 pounds of water and located behind the 582 square feet of south facing thermopane glass. The wall will act as thermal mass for heat storage, radiating heat into the home as the water in the tubes is warmed by the sun. An insulated curtain will be drawn between the glass and the wall at night or during cloudy periods to minimize heat loss through the glass. An Additional 100 square feet of south facing glass will allow for direct heat gain and lighting. The wood furnace will have ducts leading to the base of the tube wall to warm the tubes and provide the backup source of space heating.

RAE 061-POWER-761

Solar, Wind and Wood for Power and Space Heating of a Home

Grantee: **Tom Power**
Bass Creek Commune
Route 2
Stevensville, MT 59870

Grant Amount: $12,095

Award date: 11-12-76

ABSTRACT:

A system using solar, wood and wind energy appropriate for homes and small commercial buildings will attempt to show that solar, wood and wind energy can be applicable to sites in western Montana. A passive solar system using 480 square feet of air collectors will provide hot air to a 1,456 cubic foot rock storage area by operating on a thermosiphon principal. Air flow will be controlled by manually operated dampers. A wood furnace will be built into the storage area to provide additional heat during cloudy periods and the heat from the storage area will be used to heat the buildings. Electricity for the building will be provided by two, 3-kilowatt, 120-volt Jacobs wind generators with battery storage area for windless periods.

RAE 092-MACDON-761

Active & Passive Solar Home for Space Heating
—Annual Storage Device—

Grantee: **L. Clark MacDonald**
Bootlegger Trail
Great Falls, MT 59401

Grant Amount: $8,743.70

Award date: 11-17-76

ABSTRACT:

Annual solar heat storage will be attempted using a 10,000-gallon heat storage system coupled to 864 square feet of liquid solar collectors. Heat gathered and stored in the tank during the summer will be transferred by a heat pump to the 1,620 square foot home during the winter. This is the first such heat storage project in Montana.

Passive solar heating will also be used in the winter and it will be provided by a 196 square foot glazed area on the south wall of this brick home. The glazed brick area will act as a thermal mass and windows located at the top and bottom of this wall will allow the heated air to circulate by convection through the house. Backup heating will be provided by the natural gas furnace. The grantee hopes that the two systems will reduce heating costs by 65 percent.

RAE 119-MATSN-771 — **Solar Home Space Heating —Air Collectors**

Grantee: **George Mattson**
109 East Main
Bozeman, MT 59715

Grant Amount: $8,000

Award date: 7-7-77

ABSTRACT:

A combination of active and passive solar collection systems will provide space and domestic hot water preheating to a home that is recessed approximately two feet into the ground for added insulation. The 781 square foot air collector located on the slanted south wall has a unique absorber surface; it uses reflective and pleated aluminum sheets which bounce the rays of the sun back and forth within the collector until a high percentage of their heat is absorbed. Unlike conventional collectors, it is able to collect heat without using the normal black coating. The collected warm air will be blown directly into the house or placed in a rock storage bin containing a hot water tank for preheating domestic hot water.

A masonry wall placed through the central portion of the house will serve as passive solar collector and heat storage, gathering heat through skylight windows during the day and storing it for use during the night. A wood stove butted against the wall will use the wall to provide even, lasting heat during periods colder than -10 degrees Fahrenheit. A natural gas furnace will provide backup heating when needed.

RAE -133-TERZO-771 — **Passive Solar with Wood for Space and Hot Water Heating**

Grantee: **Anthony Terzo, Jr.**
820 Hilda
Missoula, MT 59801

Grant Amount: $10,000

Award date: 10-4-77

ABSTRACT:

An integrated solar and wood heating system using the principles of conduction and convection will be used for space and hot water heating and be predominantly self-operating.

The major innovative concepts that will be used in this project are: (1) a hillside air-type solar collector, located below the heat storage bin, which turns itself on and off and circulates air by convection; (2) a rock and concrete heat storage bin surrounding two concrete septic tanks full of water of custom design which uses the principles of conduction to store and release heat obtained from the solar collector and/or from a wood burning furnace; (3) a wood burning furnace of owner design which incorporates self-regulating features to maintain efficient combustion with minimum heat loss up the chimney; and (4) a rooftop, liquid solar collector to preheat domestic hot water. This is the only part of the system that needs a mechanical device (a pump) to operate. The collector can be used as an exhaust fan to aid summer cooling by opening up the top part of the collector and drawing the warm air over it and to the outside.

RAE 134-DUFLD-771 — **Passive Solar Trombe Wall with Wood Assist for Space and Hot Water Heating**

Grantee: **John Duffield**
Route 5, Pattee Canyon
Missoula, MT 59801

Grant Amount: $9,640

Award date: 7-15-77

ABSTRACT:

A masonry trombe wall making up the entire south wall of a home will provide passive space heating. Painted black and enclosed in thermopane, the wall will be aided with adjustable reflectors on a clerestory which reflects sunshine into the wall and an insulated curtain will reduce night heat loss. A masonry fireplace butted against the trombe wall and a cookstove in the kitchen will provide additional heat.

A combination of solar and wood will be used to preheat domestic hot water. One 32 square foot liquid solar collector installed in the eastern most portion of the south wall will function on the thermosiphon system and heat a 30 gallon hot water tank through a heat exchanger. Water filled piping coiled in the flue of the fireplace will also gather heat which will be transferred to the tank.

RAE 025-RECHT-772 — **Passive Solar Space Heating**

Grantee: **Peter Rechtfertig**
1030 Howard Avenue
Billings, MT 59102

Grant Amount: $1,265

Award date: 1-13-78

ABSTRACT:

A passive solar design using 98 square feet of southerly exposed window area will provide a simple, low-technology approach available for new or existing construction. The windows could be covered with insulated shutters to reduce heat loss during cold, cloudy days and at night. The south side of the attic roof line will be changed from a 45 degree to 90 degree angle and double glazing will be installed to enclose the area. No heat storage will be added, and no back-up heating supply will be provided to the room. Ducts may be installed to draw warm air from the passively heated room, through the furnace fan, and distribute it through the house.

RAE 047-SLNES-772 — **Passive Solar Heated Home —Freon Collector**

Grantee: **Norm Sulenes**
2218 Fairview Place
Billings, MT 59102

Grant Amount: $10,760

Award date: 1-31-78

ABSTRACT:

A 360-square-foot passive concentrating collector system with a 1,000-gallon storage tank will use freon as the working fluid and heat an existing 1,750-square-foot home. The use of refrigerant is expected to eliminate chemical action or corrosion in the collector hydronic circuit and allow systems to use smaller collector plates than needed with conventional liquid systems using water and antifreeze.

The collectors will be located on the ground and below the level of the insulated underground storage tank. The liquid refrigerant will flow by gravity from the storage tank to the collectors, be vaporized as it is heated by the sun and return up to the storage tank as a hot gas. A standard baseboard-type hot water fin and tube coil will be used as a heat exchanger. Copper tube and aluminum fincoils leading from the storage tank will be located in the return air duct to the forced-air furnace. A thermostatically controlled blower will bring warm air into the rooms.

The grantee will also be using 40 square feet of active liquid solar collectors on the southern slope of the roof for preheating domestic hot water. A water tank will be used as the heat exchanger and storage for this system and will be connected to the existing gas-fired hot water heater.

RAE 032-MEAN-781 — **Passive Trombe Wall and Earth Sheltered House**

Grantee: **John Means**
1616 34th Street
Missoula, MT 59801

Grant Amount: $7,000

Award date: 8-23-78

ABSTRACT:

This project is a unique combination of passive solar heating with underground architecture in a sod-roofed, 1,800 square foot dwelling that will be two-thirds underground. It will have a 400-square-foot south-facing Trombe wall, which will be the primary heat source for the house as well as the greenhouse area located at the bottom. A copper coil for preheating hot water will be placed in the Trombe wall, using water pressure from the well pump. To increase the heat storage capacity, sealed columns filled with water and containing aluminum "fins" will also be imbedded in the Trombe wall. This feature and the fact that the columns protrude from the top will assist heat transfer from the center into the path of the air flow as it circulates within the house.

A secondary wall between the Trombe and living quarters will help control the rate of heat transfer to the dwelling. The total system is designed to provide 80 percent of the heating needs. A wood stove and electrical heaters will be used for any necessary backup heating.

RAE 041-HUGH-781 — **Passive Solar Home**

Grantee: **Kurt Hughes**
120 North Custer Avenue
Miles City, MT 59301

Grant Amount: $5,400

Award date: 8-16-78

ABSTRACT:

A 486 square foot glass area will channel light across a sunken living room to an 8 foot by 30 foot dark colored wall, which will serve as the main solar collection mass for a 1,200 square foot home and provide radiant space heating. Water-filled PVC pipes will increase the heat storage capacity of the wall. The rooms have been positioned to allow all but the back bedroom and storage room to be in direct contact with the wall. Ducts will take warm air to the back bedroom and the storge room will be warmed by heat escaping from the hot water heater. The floor of the sunken living room will act as a cool air trap and be heated by a wood stove. Manually operated insulated shutters will cover the large glass area at night and a white nylon sun shade will be used to shade the window area in the summer. The passive operation should provide for 60 percent of the heating requirements of the house, with a heat pump used as backup heat.

RAE 054-COBT-781 — **Attached Solarium and Space Heating Assist**

Grantee: **Robert Corbett**
P.O. Box 3706
Butte, MT 59701

Grant Amount: $5,913

Award date: 7-27-78

ABSTRACT:

A 720 square foot "solarium" will be added to a unique concrete building which is being converted into a residence. The solarium will be covered with 1,440 square feet of double-skinned acrylic sheets and the walls of the structure and the concrete slab floor in the solarium will be used for heat storage. Warm air will be drawn from the top of the solarium into a manifold and routed into the residence with a fan activated by a differential thermostat. Ducts will take air from the coolest portions of the residence into the solarium. The grantee will also be designing and installing special vents that wil operate by air hydrolics and will prevent summertime overheating. The solarium is expected to provide 75 percent of the space heating needs and backup heating will be provided by a wood stove.

DOMESTIC HOT WATER

RAE 006-NORDT-761 — **Solar Heating of Domestic Hot Water for Apartment Complex Use**

Grantee: **Kenneth Nordtvedt**
Physics Department
Montana State University
Bozeman, MT 59717

Grant Amount: $4,000

Award date: 11-12-76

ABSTRACT:

This project will be to construct, instrument, operate and study a solar preheater for the domestic hot water system of an 11-unit apartment building. The economics of large scale domestic hot water systems can be studied from the results of this project. This system will incorporate 320 square feet of single and double-glazed flat-plate collectors, which will be placed in four rows on the roof of a garage next to the apartment building. During spring, summer and fall, white panels will be installed to reflect solar radiation on the back row of the collector panels. A 120-gallon tank will be used for heat exchanger and storage. Backup hot water will be supplied through the building's natural gas hot water tank.

RAE 145-CLDWL-771 — **Solar Hot Water System for Retirement Apartment Complex**

Grantee: **Major Caldwell**
Horizon Lodge
701 S. Wisconsin
Conrad, MT 59425

Grant Amount: $79,013

Award date: 7-18-77

ABSTRACT:

Nine hundred square feet of solar collectors will preheat domestic hot water for an 84-unit retirement apartment building. The solar collectors mounted on the roof of the building will use a heat transfer fluid to carry heat to a heat exchanger, which in turn preheats water in two 800-gallon storage tanks. The grantee estimates that the system will provide 50 percent of the heat needed for domestic hot water and, through the project, would develop a methodology for applying solar technology to existing large buildings.

A large cooling unit will use ambient air to cool the heat transfer fluid should the storage temperature exceed a safe maximum (200°). This way the collector heat will be dissipated by this unit before it can further heat up the storage.

Another item that this installation required was a mixing valve to blend cold water with the storage tank water when the water drawn from those tanks is above 140°F. This prevents too hot water from being used in showers and sinks and yet allows maximum heat storage to build up in the storage tanks.

RAE 054-CLWRS-772 — **Solar Hot Water Preheating**

Grantee: **Barbara Clowers**
700 Seventh Avenue North
Great Falls, MT 59401

Grant Amount: $3,080

Award date: 1-24-78

ABSTRACT:

This retrofit project is for a domestic hot water preheating system using a manufactured liquid solar collector unit consisting of three flat-plate collectors, a 66-gallon hot water tank and all required accessories and controls. The solar hot water tank will act as a preheater for the existing gas hot water heater. The automatic controls use a differential thermostat to sense temperature difference between the storage tank and hot water tank, and will turn the collector loop section on and off as required. The existing natural gas water heater will serve as backup for the solar system. Monitoring equipment will be placed on this system to determine its efficiency under normal household conditions.

RAE 097-HRDC-772 — **Solar Domestic Hot Water Systems for Low-Income Homes**

Grantee: **Mike Barton**
Dist. #11 Human Resources Council
207 East Main
Missoula, MT 59801

Grant Amount: $15,000

Award date: 6-7-78

ABSTRACT:

This project will be to retrofit six low-income homes with hand built active solar hot-water systems.

The collectors will be built by the District 11 Human Resource staff and the component parts, such as the valves, fittings and preheat tanks, will be obtained commercially. Each system will have between three and four solar collectors that will use silicon as the heat gathers and transfers fluid and will heat water in preheat tanks ranging from 66 to 80 gallons. All of the systems will be installed by the staff and detailed plans for the systems and the building techniques used will be published at the end of the project.

GREEN HOUSES

RAE 149-GOBBY-771 — **Solar Heated Greenhouse for Winter Operation**

Grantee: **Peter Gobby**
208 S. Willson
Bozeman, MT 59715

Grant Amount: $12,000

Award date: 7-11-77

ABSTRACT:

A 16 foot by 40 foot greenhouse will be designed and constructed using some unusual building techniques to maintain adequate growing temperatures in the winter with little nonrenewable energy consumption. The structure will have large adjustable reflectors **above** the glazing area to increase light intensity during the winter, which can be hinged down over the glazing to prevent excessive heat gain during the summer. The greenhouse will be sunk into the ground three feet and insulated on the **outside** of the concrete foundation walls as well as heavily insulated on the north side of the roof. Heat will be stored inside 60, 55-gallon black barrels filled with water. The grantee will monitor the inside temperatures during winter and the effects of the reflectors to determine whether they can make up for the short daylight periods and permit vegetable growth that would be marginal with normal winter light levels.

RAE 150-BRWN-771 — **Commercial Sized and Energy Self-Sufficient Solar Greenhouse**

Grantee: **John Brown**
Box 216
Circle, MT 59215

Grant Amount: $12,500

Award date: 7-15-77

ABSTRACT:

Solar, wind, wood and compost will be used to operate a commercial-sized passive solar greenhouse. The integrated system will use passive solar for plant growth, dehydration, preheating hot water and turning ventilators on top of the building for an air exhaust system. Heat will be stored inside water containers, earth and concrete. A wind generator will provide electricity for operating the wide spectrum growing lights, emergency air exhaust and pumping well water for the plants. A compost heap will provide heat, carbon dioxide and fertilizer. Auxiliary heat will be obtained from a wood furnace.

The relationship between wind speed and solar intensity; whether an integrated system can effectively address the problems of energy variation and storage; the extent interior climate changes are controllable with the system and the effects of all this on plant viability. Labor required for effective management will be noted to determine the economic aspects of this system.

RAE 153-FRKLN-771 — **Passive Solar Greenhouse With Wood Assist for Home Space Heating**

Grantee: **Gary Franklin**
4428 Sixth Avenue South
Great Falls, MT 50401

Grant Amount: $5,000

Award date: 7-11-77

ABSTRACT:

A solar greenhouse will be constructed on the south side of the home and a wood heater will be installed which will work in conjunction with the greenhouse to provide heat for both units. The solar heat will be stored in twelve 30-gallon drums filled with water, and vents will be installed at floor and ceiling levels to promote the natural flow of convection currents between the greenhouse and the living quarters. A fan will also be installed in the window adjacent to the wood burning stove to draw heat into the greenhouse when needed. Sliding shutters of masonite and styrofoam, which will work similar to a roll-top desk, will be used to cover the glass area at night and during cloudy periods. The grantee expects the combination of the wood and solar system to provide up to 90 percent of the space heating requirements of the home because of the ideal configuration of the house floor plan.

RAE 061-STDMN-772 — **Attached Solar Greenhouse**

Grantee: **Stan Steadman**
320 East Power
Glendive, MT 59330

Grant Amount: $1,240

Award date: 2-7-78

ABSTRACT:

This project will demonstrate a 135-square-foot greenhouse which will be attached to the southwest corner of the house and is similar to those built in a Solar Sustenance Project in New Mexico. Heat will be stored for nighttime use in rows of 55-gallon black-painted barrels. As an addition to the New Mexico design, three 2-foot-by-8-foot air collectors will be built into the roof of the greenhouse, to hopefully allow it to function throughout the winter in Montana's harsh climate. A 3½-inch fan will blow hot air through baffles in the collectors and through ducts into the greenhouse floor to add operating efficiency to the system. The active solar system will be used only during periods of extreme cold. The grantee expects the greenhouse to achieve all of its heating needs through these solar systems and therefore has no backup system planned.

RAE 046-EKSM-781 — **Greenhouse Using Composting Heat Source**

Grantee: **Jim and Doris Ekstrom**
P.O. Box 1010
Clinton, MT 59825

Grant Amount: $3,144

Award date: 7-27-78

ABSTRACT:

A 210 square foot greenhouse having 400 square feet of solar collection area will use a closed chamber aerobic composter and 12, 55-gallon black barrels filled with water to supply 100 percent of its heating needs and provide some space heating to the residence. The composter will use three cubic yards of manure per month for "fuel" and the hot vapor produced as the manure decomposes will be drawn through four inch stove piping to radiate heat into the greenhouse then vented outside. Heat production will be regulated by a thermostatically controlled squirrel cage fan connected to the base of the air outflow pipe. Vents in the wall between the greenhouse and residence will allow circulation of cool air into the greenhouse and warm air into the residence. A movable reflector plate that can rise four feet above the roof line of the greenhouse will be used for added solar collection.

RAE 047-MCLM-781 — **Attached Solar Greenhouse Using Trickle Collector and Wood Stove for Heating —Also Wind Study**

Grantee: **Bruce McCallum**
P.O. Box 607
Chester, MT 59522

Grant Amount: $3,159

Award date: 8-24-78

ABSTRACT:

A solar panel and water circulation system will be integrated with a wood stove to provide year-round heating of a greenhouse, partial home space heating and pre-heating of domestic hot water. Water will flow from a 64 square foot trickle collector mounted on the roof of the house into nine 55-gallon water barrels located in the greenhouse. Using check valves, water from these storage barrels can pass through a copper coil wrapped around the domestic hot water tank for preheating. A separate loop will bring water from the storage across the existing wood stove in the basement to heat the water when solar radiation is insufficient. Each loop is operated automatically and independently by a small pump controlled by differential thermostats. The grantee will also perform a wind study independent of this project to determine whether a wind generator and electrical distribution system is feasible for the area.

RAE 051-JONS-781 — **Passive Solar Greenhouse for Home Space Heating Assist —Thermosiphon Liquid Collectors**

Grantee: **Richard Lloyd-Jones**
Route 1
Ennis, MT 59729

Grant Amount: $1,849

Award date: 8-8-78

ABSTRACT:

A 10 foot by 18 foot greenhouse having 350 square feet of glazing will be attached to the south side of a home and will use two, four-foot square liquid flat plate collectors and 12, 55-gallon black barrels filled with water for heat collection and storage. The collectors will be located on the slope in front of the greenhouse and water will flow by thermosiphon from two, 55-gallon drums welded together. The barrels and collectors will provide radiant heat for the greenhouse and partial space heating of the home by heat transfer through a 6 foot by 7 foot door between the structures. Ducts will draw cool air from the floor of the home into the greenhouse and vents near the greenhouse roof will pull solar heated air into the house. Half of the flat greenhouse roof will be solid to avoid overheating in summer and prevent heat loss in the winter. The greenhouse has no backup and is expected to provide 10 percent of the home's space heating needs.

RAE 052-HNSN-781 — **Attached Solar Greenhouse for Passive Space Heating**

Grantee: **J. Levi Hanson**
Box 1776
Gilford, MT 59525

Grant Amount: $6,446

Award date: 7-27-78

ABSTRACT:

A south-facing greenhouse having 444 square feet of glazing and overhangs designed to shade the summer sun will be added to a house and will use 48, 55-gallon black drums placed against the top of the structure and routed into a storage area containing 15 tons of river rock located underneath the greenhouse. Heat can be drawn from the rock storage into the house using a motorized air damper and fed into the forced air furnace assembly. Hinged insulation panels equipped with a magnetic seal can be dropped sulation panels equipped with a magnetic seal can be dropped over the glazing to limit heat loss at night and cloudy days. Turbine ventilators will be used for summer venting of the greenhouse. No backup heating has been provided since the system is expected to supply 100 percent of the greenhouse heating needs and should be able to provide 55 percent of home space heating.

SWIMMING POOLS

RAE 078-SHELBY-772 — **Solar Heated Swimming Pool**

Grantee: **City of Shelby**
Rae Kalbfleisch
P.O. Box 518
Shelby, MT 59474

Grant Amount: $36,800

Award date: 3-28-79

ABSTRACT:

Fifty roof-mounted liquid solar collectors set at a 48° angle will be added to the present heating system of an enclosed pool to heat the pool, the swimming area and the bathhouse. Control of the system will consist of a differential thermostat sensing collector and pool water temperature. The heated water from the integrated system will be pumped directly into the pool, allowing year-round solar heating.

RAE 070-HAML-781 — **Solar Municipal Swimming Pool**

Grantee: **City of Hamilton**
Ray Thrailkill, Mayor
Box 709
Hamilton, MT 59840

Grant Amount: $38,320

Award date: 7-27-78

ABSTRACT:

An active solar panel array consisting of 48 locally manufactured liquid flat plate collectors will be installed on the roof of the municipal pool dressing room to provide hot water for the pool. The collectors will use a silicone base heat transfer fluid to prevent freezing in the collectors and piping. When excess heat is available, some of the hot fluid will be diverted to the shower heat exchanger and preheat tanks. The solar system is expected to provide 85 percent of the heat requirements for the pool. The City of Hamilton will also be installing energy conservation devices to help prevent heat and evaporation loss at night and during off-hours and will be upgrading the quality of the pool equipment.

PHOTOVOLTAIC

RAE 168-BARET-771 — **Solar Powered Radio Repeater System**

Grantee: **Lee Barrett**
Electronics Research Lab
Montana State University
Bozeman, MT 59717

Grant Amount: $5,314

Award date: 7-20-77

ABSTRACT:

A radio repeater station powered by photovoltaic cells will be assembled and installed on Eaglehead Mountain (30 miles south of Bozeman) and enable VHF radio communications in the area for amateur radio operators which currently does not exist. The 10 watt amplifier will operate on 146.22 MHZ input and 146.88 MHZ output and will be a "open" repeater, available to any ham radio operator having the proper channels. Data sensors will give the grantee operational information to allow monitoring of system functions. This project will establish one of the first solar photovoltaic powered amateur radio repeaters in the country

RESEARCH AND DEVELOPMENT

RAE 032-HERNDON-761 — **Solar Heating System Evaluation**

Grantee: **Charles Herndon**
Mineral Research Center
Montana College of Mineral Science and Technology
Butte, MT 59701

Grant Amount: $15,000

Award date: 11-22-76

ABSTRACT:

A variety of active liquid solar heating components will be evaluated under diverse solar conditions through this project. Eight different collectors (23 square feet each) will be mounted on adjustable frames so that the collection angle can be varied anywhere between 30 and 90 degrees. A variety of materials will be used for the absorber plates in the collectors, including: copper, aluminum, and plastic. Four different types of glazing materials will be used: low-iron glass, carbonate, acrylic, and fiberglass. Each collector will have a different flow configuration for moving liquid through the absorber plate. Four of these collectors have been constructed at the college's shop complex, while four others will be commercially manufactured. Each of these collectors will be connected to a 750-gallon heat storage tank which will serve as the space heating source for a liquid baseboard heating system used to heat an office area. An electric water heater will be used as a backup heat source. The solar systems will be heavily monitored so that component and system efficiency can be determined. The long range plan for this facility is to be able to test any liquid type collector to determine its overall efficiency rating.

RAE 051-HRNDN-772 — **Solar Heating Systems Evaluation**

Grantee: **C. Nels Anderson**
Charles Herndon
Mineral Research Center
Montana Tech
Butte, MT 59701

Grant Amount: $13,570

Award date: 6-1-78

ABSTRACT:

The efficiency of a liquid solar heating system, installed under RAE 032-HRNDN-761 and being used to heat the office area at the Mineral Research Center, will be tested and monitored. The system will be connected to a computer which will be programed to determine efficiency and heat output per square foot by measuring collector temperature, heat transfer, storage temperature and other features, which will then serve as a basis for structuring a complete computer program for sizing and selection of solar components.

RAE 171-ANDRSN-782 — **Solar Collector Testing Facility**

Grantee: **C.Nels Anderson**
Charles Herndon
Mineral Research Center
Montana Tech
Butte, MT 59701

Grant Amount: $30,700

Award date: 5-1-79

ABSTRACT:

Based on the information gained from RAE 051-HRNDN-772, a solar collector test facility will be established that could perform certified efficiency and material tests on liquid and air collectors

of all types. The National Bureau of Standards' and the State of California's collector certification will be obtained and the grantee will also compile solar insolation data at the facility.

RAE 046-FWLKS-761 — **Solar Insolation Measurement for Montana (SIMM)**

Grantee: **Charles Fowlkes**
1820 South 7th Avenue
Bozeman, MT 59715

Grant Amount: $29,790 (FY 77)

Award date: 11-12-76

ABSTRACT:

This program will measure incoming solar radiation (insolation) at 20 measuring stations located at high schools across Montana. The measurements will provide specific data for computing solar energy gain in order to properly size active and passive solar heating systems. The high school students and science teachers operating the measuring equipment will help to lower the cost of data collection while learning about the potentials of solar energy. A handbook of solar energy experiments designed for high school students will also be included in the program.

RAE 084-FWLKS-772 — **Continuation of SIMM Program**

Grantee: **Fowlkes Engineering**
Charless Fowlkes
31 Gardner Park Drive
Bozeman, MT 59715

Grant Amount: $35,490

Award date: 1-4-78

ABSTRACT:

This project will continue the program begun under RAE 046-FLWKS-76 for measurement of solar radiation and add an additional ten stations to the system data base.

Using high schools for the monitoring sites and volunteer science teachers and students for the station monitors has been quite successful during the previous project. Normal maintenance and repair has been carried out without significant loss of data and the accuracy has exceeded the grantee's initial expectations. At the completion of this project, the grantee will combine and analyze both years measurements which will be prepared and published as a solar data manual.

RAE 140-FLWKS-782 — **Continuation of SIMM Program**

Grantee: **Fowlkes Engineering**
Charless Fowlkes
31 Gardner Park Drive
Bozeman, MT 59715

Grant Amount: $35,765

Award date: 4-17-79

ABSTRACT:

The grantee will continue to gather solar radiation data at the 30 high school locations and add this information to the two years of data already accumulated. He will also update and expand the solar experiments handbook.

RAE 142-SHELY-771 — **Suitable Materials and Fluids for Domestic Solar Hot Water Systems**

Grantee: **Thomas Shelley**
Metallurgical Engineering Department
Montana College of Mineral Science & Technology
Butte, MT 59701

Grant Amount: $14,812

Award date: 7-20-77

ABSTRACT:

Materials and fluids for liquid solar collectors and heat exchangers will be studied for their effectiveness in Montana. Propylene glycol, ethelene glycol, kerosene and water will be studied as fluids; copper and aluminum will be studied for collector construction as will single and double glazing. Key factors under consideration will be the fluid's heat transfer efficiency, the material's resistance to deterioration, and possible system cost in order to devise a combination for an effective low-cost liquid collector and heat exchanger for Montana residents.

RAE 176-DRMHL-771 — **Study of Natural Reflectors for Use With Vertical Solar Collectors**

Grantee: **John Drumheller**
Department of Physics
Montana State University
Bozeman, MT 59717

Grant Amount: $12,990

Award date: 7-11-77

ABSTRACT:

A variety of natural reflective surfaces such as gravel, asphalt, grass, snow, and sand, will be tested to determine whether the reflected light carries the types of energy that can be captured and used by a vertical flat plate solar collector. Wavelengths as well as intensities will be measured and recorded.

RAE 091-BLGRD-076 — **Feasibility Study for Solar Junior/Senior High School**

Grantee: **Belgrade Public Schools**
Ralph Kroon, Supt.
School District #44
Belgrade, MT 59714

Grant Amount: $10,750

Award date: 11-22-76

ABSTRACT:

This project will be a feasibility and pre-engineering study for solar heat application to a new high school in Belgrade, Montana, which will be constructed in 1978-79. The study will include assessments of climatological data, mechanical systems, both active and passive solar integration systems, fuels, lighting, as well as an economic analysis comparing natural gas and electric heat systems to the proposed solar system. This study will be Phase I of a three-phase project. Phase II will incorporate the design of the new school and Phase III will be the actual building of the school and installation of a solar system.

RAE 069-BLGRD-772 — **Design Plan for Solar System in Junior/Senior High School (Phase II)**

Grantee: **Belgrade Public Schools**
Ralph Kroon, Supt.
School Dist. #44
Belgrade, MT 59714

Grant Amount: $1,500

Award date: 5-22-78

ABSTRACT:

This grant will be used for the architectural design incorporating a solar heating system into the new Belgrade school building. This project is Phase II of a three-phase project to integrate a solar system into the new school. (See RAE 091-BLGRD-761 for Phase I details). A final proposal to build the system that has been three years in the planning should be submitted to the Department in the second grant period of 1978. This will fit into the construction schedule of the new school and would result in one of the only solar heated schools in the Northwest.

RAE 064-BDGLY-772 — **Feasibility Study for Underground Passive Solar/Wood Heated Conference Center**

Grantee: **John Badgley**
Institute of the Rockies
622 Evans
Missoula, MT 59801

Grant Amount: $3,675

Award date: 2-15-78

ABSTRACT:

This project will compile current information on earth-sheltered buildings to determine the feasibility of an earth-sheltered, wood-heated conference center planned near Missoula. If constructing the building appears to be feasible, a final design will be prepared. This project can make a contribution towards meeting future energy needs in Montana by showing: (1) the economics of subterranean architecture; (2) the potential for energy savings in underground structures; (3) the potential for passive solar space heating in underground structures; (4) the potential for combining storage systems of passive solar and wood; and (5) the desirability of the environment created through sub-terranean architecture.

RAE 086-STEWART-772 — **Research Into Covenants for Solar Subdivision Development**

Grantee: **Thomas Stewart**
8945 Douglas Circle
Helena, MT 59601

Grant Amount: $3,000

Award date: 12-11-78

ABSTRACT:

This study will attempt to make a clear simple definition of that corridor or sector of space in which useful sun radiation is available for solar energy use and which should not be shadowed by adjacent landowners. Since one of the most important protections needed for solar developments is the right to the sun, this study will be to provide a model set of covenants for subdivision use by studying the geometry of the sun's location in relation to property and will provide a legal and technical explanation of the terms used.

RAE 088-FWLKS-772 — **Monitoring of Five Solar Homes**

Grantee: **Charless Fowlkes**
1820 S. Seventh Avenue
Bozeman, MT 59715

Grant Amount: $30,000

Award date: 6-14-78

ABSTRACT:

Five solar heated homes funded through the grant program will be monitored to determine the efficiencies of each system. The monitoring will include a calculated and measured analysis of the heating requirements of each home; a full description of the solar heating system and its integration into each structure and a full technical analysis of how well the solar system meets the heating requirments of the home. The efficiency of individual components will be determined whenever possible. The five homes chosen to be studied were selected in order to represent a full spectrum of solar heating options now available, such as active or passive and liquid or air. The grantee will verify all findings from this study using the data measured at each location.

RAE 140-FOLKS-790 — **Performance Monitoring of Hamilton Solar Pool**

Grantee: **Fowlkes Engineering**
31 Gardner Park Dr.
Bozeman, MT 59715

Grant Amount: $10,145

Award date: 5-2-79

ABSTRACT:

The thermal performance of the solar/natural gas heated swimming pool in Hamilton will be monitored using one of the computer-based data acquisition systems being used by the Department to monitor solar homes. The final report will include daily summaries of the hourly data showing total solar gain, collector efficiency, solar shower heat, solar pool heat, pool auxiliary heat, average pool temperature, average ambient temperature, total collector insolation and total horizontal insolation. Collector efficiency curves will be plotted and summary information and conclusions on the total system performance will be detailed.

RAE 113-FLWKS-772 — **Purchase of Infrared Scanner for Solar System Efficiency Testing**

Grantee: **Fowlkes Engineering**
31 Gardner Park Drive
Bozeman, MT 59715

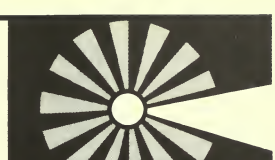
Grant Amount: $35,583

Award date: 6-13-79

ABSTRACT:

A portable infrared scanning device, capable of making remote rapid temperature measurements over an area from the infrared emissions off the surface, will be purchased to perform a heat loss and general performanance evaluation of four solar heating systems funded through the program. The equipment can be used to detect flow restrictions in collector arrays, air leaks in storage devices or ducting, inconsistencies in insulation layers and any large areas of heat loss in the thermal shell of the solar-heated structure. Video tape cassettes will be produced that will show the areas of heat loss in each of the solar heating systems and buildings.

WIND



RAE 239-GUSTFSN-761 — **Paddlewheel-Type Windmill**

Grantee: **LeRoy Gustafson**
Box 1168
Cut Bank, MT 59427

Grant Amount: $4,800

Award date: 11-12-76

ABSTRACT:

A low-cost paddlewheel-type windmill will be designed which will include a deflector to prevent the wind from hitting the bottom part of the paddlewheel that is moving into the wind. The grantee will attempt to design the windmill with a slow enough tip speed so that the tip does not need to be feathered in order to prevent self-destruction in high winds. A wind tunnel will be built to conduct experiments with a model of the device to determine the most economical position and size of the deflector and the number and shape of the paddlewheel blades. A 10 × 20 foot windmill, which will be made without using any special industrial equipment and constructed out of scrap materials to keep costs at a minimum, will then be built and tested. This design, if successful, should be especially useful to Montana farmers and ranchers since it could be built with no outside help and most of the materials could be found at low cost.

RAE 204-DRPS-771 — **2Kw Dunlite Home Wind Generation System with Utility Interface**

Grantee: **Drapes Engineering**
292 Eklund
Great Falls, MT 59401

Grant Amount: $19,375

Award date: 7-11-77

ABSTRACT:

Based on the information gained from RAE 235-DRPS-761, the grantee will install and monitor a 2 kilowatt Dunlite wind generation system which will work in conjunction with the existing power grid using a synchronous inverter. Because the utility network will provide the back-up energy, no storage will be required for windless periods and the net energy gain of the system should be improved. Using electric meters, the grantee will note the amount of power going from the inverter to the home and the amount going into the utility network to determine how large a portion of the electrical needs is being supplied by the wind generator.

RAE 209-KELLY-771 — **Winco 400 Watt Home Wind Generator**

Grantee: **John Kelly**
Star Route 1
Libby, Mt 59923

Grant Amount: $3,500

Award date: 8-18-77

ABSTRACT:

A 400-watt wind generator will be mounted on a 30-foot tower and used to charge twelve, 345 amp-hour deep cycle batteries which will provide electricity for the home. Wind speed will be recorded by a monitor on the tower and the grantee will make reports on the efficiency of the system.

RAE 206-STKIN-772 — **Homemade Wind Powered Air Compressor**

Grantee: **Bill Stockton**
Grass Range, MT 59032

Grant Amount: $1,385

Award date: 1-24-78

ABSTRACT:

This project will be to construct a homemade savonius type windmill that will be used to power an air compressor. The windmill will be built from 55-gallon barrels, cut and welded into place, and should supply enough power to pump air into a 50 gallon air compression tank. The compressed air can then be used to power air motors or small electric generators.

RESEARCH AND DEVELOPMENT

RAE 235-DRAPES-761 — **Wind Monitoring at Tracy**

Grantee: **Drapes Engineering**
292 Eklund
Great Falls, MT 59401

Grant Amount: $5,093

Award date: 11-23-76

ABSTRACT:

This project will be to measure wind at a hilltop near Tracy for a one-month period and estimate how much energy the wind could produce. The measuring instruments will be a three-cup anemometer, two temperature sensors, and a wind direction vane. One temperature sensor, the anemometer and direction vane will be mounted atop a 38-foot guyed tower. The second temperature sensor will monitor the inside temperature of the equipment shed housing the electronic digital interface equipment, which will convert signals from the instruments into usable data. Then, if the measurements and correlated U.S. Weather Service data indicate there is enough wind to produce usable energy, an estimate of the amount of energy a wind machine could produce at the site will be made.

RAE 252-DELP-761 — **Domestic Sized Wind-Electric System**

Grantee: **Bill Delp**
Independent Power Developers, Inc.
Box 1467
Noxon, MT 59853

Grant Amount: $64,256

Award date: 11-12-76

ABSTRACT:

A wind-electric generation system capable of meeting most of the power requirements of an all-electric household will be designed and constructed using a wind generator of three, 33-foot diameter blades with a gear reduction of 15 to 1. The system should be able to produce direct-current electricity in winds as low as 6 miles per hour and produce a maximum of 24 kilowatts in winds of 25 miles per hour. The windmill blade will be a "fixed" propeller type, designed so that the pitch can be adjusted by a movable wedge-shaped shim at the point of attachment to the hub and designed so that it could be readily mass produced. The blade's speed will be governed by an electronically-controlled field current using four, 6 kilowatt generators that will slow down the rotational speed and prevent self-destruction in high winds. Electricity will be stored in a bank of deep-cycle batteries and used in windless periods.

RAE 220-SCHMIDT-761 — **Wind Energy/Synchronous Inverter**

Grantee: **V. Hugo Schmidt**
Physics Department
Montana State University
Bozeman, MT 59717

Grant Amount: $7,346

Award date: 11-12-76

ABSTRACT:

The purpose of this project is to develop a reliable low-cost inverter of an intermediate size (1-2 kilowatts) that can be used with small wind systems and can convert their output into an alternating current which can be fed into existing power grids. The grantee will also attempt to improve the efficiency of the DC to AC conversion of the inverter and make an estimate of the production costs for the device. A model of the inverter will be field tested of a wind generator now in operation at Montana State University.

RAE 201-SCHMT-771 — **Continued Synchronous Inverter and Ducted Rotor Wind Generator Development**

Grantee: **V. Hugo Schmidt**
Physics Department
Montana State University
Bozeman, MT 59717

Grant Amount: $19,640

Award date: 7-18-77

ABSTRACT:

The grantee will continue development of a low-cost synchronous inverter and add another component which will enable operation either with or without a synchronous signal. The aim is to develop a more efficient inverter, capable of producing a better wave and providing the proper load to a wind or small hydroelectric generator.

The grantee will also develop and test three types of ducted windmill systems that are designed to function inside fixed barriers which funnel the wind to increase air velocity to the rotors, which will provide design criteria for a system that will function within the wind shelterbelts or in the open environment.

RAE 205-LRSBK-771 — **Wind Monitoring at the Cascade School**

Grantee: **Wayne Lersbak, Supt.**
School District #3 and 3b
Cascade, MT 59421

Grant Amount: $10,000

Award date: 9-1-77

ABSTRACT:

Students and teachers at the Cascade school will participate in a project to determine the feasibility of using wind-generated electricity for space or domestic hot water heating or other electrical needs at the school. Besides assisting in the daily upkeep of the wind monitoring system, students will view slide presentations by the project engineer on a variety of renewable energy topics.

The equipment for the project includes an anemometer mounted on a 40-foot guyed tower, data interface system, paper tape punch and an equipment shelter located at the foot of the tower. The entire data interface system and the paper tape punch will operate on 24 volt D.C. power supplied by two automotive lead-acid batteries and have an underground power line from a nearby construction site to recharge the batteries and to heat and light the equipment shelter. Data recorded from this project will be correlated with wind speed measurements made at the weather station in Great Falls.

RAE 206-LEO-771 — **Small Scale Wind Generation System**

Grantee: **Robert Leo**
Electronics Research Lab
Montana State University
Bozeman, MT 59717

Grant Amount: $8,035

Award date: 7-11-77

ABSTRACT:

A wind-powered electric generating system will be developed to study the practicability of unfeathered propeller systems, the use of braked systems, and to determine whether a reliable low-cost wind electric system is feasible for Montana mountain tops. The grantee intends to develop a reliable, low-cost, nearly maintenance-free wind generator that can be used with a simple modern electronic control system.

RAE 202-GORDN-772 — **Wind Monitoring Near Cascade**

Grantee: **John Gordon**
Box 347
Cascade, MT 59421

Grant Amount: $2,000

Award date: 5-3-78

ABSTRACT:

Wind monitoring equipment will be installed at a farm site 19 miles south of Cascade, Montana, to determine whether there is enough wind there to power a wind generator before investing in equipment. Monitoring will be for a period of three to six months. The data will be analyzed and compared with the energy requirements and output capabilities of several wind powered electric systems to determine the best system for the site.

RAE 212-BREL-781 **Wind Survey of Livingston Area**

Grantee: **Donald Brelsford**
Brelsford Engineering
315 Haggerty Lane
Bozeman, MT 59715

Grant Amount: $17,295

Award date: 8-4-78

ABSTRACT:

This project is intended to identify windy sites on or near the top of hills and ridges between Livingston and Springdale and monitor those sites to provide data needed to plan for wind turbine installations.

The data gathered will be correlated and analyzed with the Livingston FAA station reports in order to allow comprehensive, long-term projections. Nine sites will be selected within the area and a portable wind speed recorder will be installed for a three-month monitoring period at each site (monitoring height will be the national standard of 10 meters). As the actual wind data is measured and recorded at the survey sites, average wind correlation and simulation models will be prepared. These models will then be used to forecast probable wind conditions and wind power potential during an average year at the nine survey sites selected.

RAE 203-OHAIR-782 **Wind Monitoring and System Testing**

Grantee: **Ed O'Hair/Charles Green**
MERDI
P.O. Box 3809
Butte, MT 59701

Grant Amount: $100,000

Award date: 6-11-79

ABSTRACT:

Two, 120-foot towers will be constructed and used to hold separate sets of monitoring equipment which will record wind speeds at two different heights. The towers will be located at Livingston and Whitehall. The grantee will also perform a complete design and performance analysis on a 18 to 36 kilowatt wind electric unit, which will be tested at a site near Whitehall. The unit will be connected to the utility power grid to assess its performance and the problems associated with linking the unit to the utility system. The data will be correlated to data collected by local weather stations and information gathered from RAE 212-BREL-781.

RAE 200-SCHMT-790 **DC/AC Inverter Bench Testing**

Grantee: **V. Hugo Schmidt**
Physics Department
MSU
Bozeman, MT 59717

Grant Amount: $5,841

Award date: 5-16-79

ABSTRACT:

The grantee will purchase a 5-kilowatt maximum output DC/AC inverter which will be tested in the laboratory to determine its entire operating range in efficiency, AC wave form, voltage stability and frequency variation. Both wind generator and small hydroelectric generator voltage requirements will be simulated in the lab and the results of this testing and methods used will be described in detail in the final report. The inverter will then be tested by the U.S. Department of Energy's small wind test facility at Rocky Flats the following year so that both lab and field testing can be reported and compared.

EDUCATION

RAE 013-AERO-761 — **New Western Energy Show**

Grantee: **Alternative Energy Research Organization**
435 Stapleton Building
Billings, MT 59101

Grant Amount: $24,480

Award date: 11-12-76

ABSTRACT:

The New Western Energy Show brings information and workshops concerning renewable energy to a large number of Montanans who might otherwise have difficulty in obtaining information about renewable energy. During the New Western Energy Show's stay in a community, which can be as long as a week, show personnel conduct activities that include:

1) Helping community members build a solar hot water heater and install it in a local building;
2) Displaying wind generators, solar panels, methane generators, small hydropower systems and other operational renewable energy equipment;
3) Graphically illustrating the application of generating methane from materials available from homestead, feedlot, municipal sewage, and other sources;
4) Demonstrating inexpensive ways to save energy;
5) Distributing books and pamphlets about energy use and conservation;
6) Entertaining and informing audiences about renewable energy through music and theatrical presentations.

RAE 707-NWERS-771 — **New Western Energy Road Show**

Grantee: **Kye Cochran & Wilbur Wood**
AERO
435 Stapleton Bldg.
Billings, MT 59101

Grant Amount: $44,800

Award date: 7-20-77

ABSTRACT:

This project will be to take the New Western Energy Show (see RAE 013-NWERS-76) on the road. They will bring the workshop/entertainment show to Roundup, Miles City, Glasgow, Great Falls, Kalispell, Hamilton, Missoula, Helena, Livingston and Billings.

RAE 704-AERO-772 — **Energy Demonstration Center for New Western Energy Show**

Grantee: **Kye Cochran**
AERO
435 Stapleton Building
Billings, MT 59101

Grant Amount: $24,800

Award date: 1-19-78

ABSTRACT:

Funds for this project will help establish a year-round renewable energy demonstration center for the New Western Energy Show (see RAE 013-NWES-761). A few of the major goals that this center hopes to accomplish are to: (1) maintain and update the New Western Energy Show's exhibits, devices and information displays; (2) conduct practical workshops about the use of renewable energy; (3) organize conferences for energy organizations of energy conservation, renewable energy and appropriate technology; (4) continue to develop and present lectures, slide shows, films and video tapes relating to energy for the general public; and (5) develop energy educational programs for elementary and secondary schools, colleges, universities, senior citizens associations, public service organizations and professional organizations.

RAE 708-OPI-772 — **Energy/Environment Simulator for Statewide Energy Education Program**

Grantee: **Office of Public Education**
Ed Eschler
Capitol Building
Helena, MT 59601

Grant Amount: $3,000

Award date: 1-17-78

ABSTRACT:

This project will be to purchase and make available an Energy/Environment Simulator to local schools to enable students to become aware of the need to conserve energy and the need to develop renewable alternative energy sources. The simulator presents the interrelationship between energy sources, their supply, their demand, their limit, and the environmental repercussions of their use. The device is a simple analog computer. Each participant controls a resource and its use, trying at all times to meet the lifestyle demanded by the population under the restraint of environmental compatability, all within a pre-set time limit.

RAE 072-AEROW-772 — **Solar Heated Home/Office, Renewable Library and Information Center**

Grantee: **AERO-West**
323 West Alder
Missoula, MT 59801

Grant Amount: $6,498

Award date: 1-31-78

ABSTRACT:

Members of AERO-West will retrofit the Horizon House with alternative energy devices so that it will become a model for the public to visit and gather information on renewable energy and energy conservation systems. Members will conduct workshops in which the participants will help build the active solar space heating system. Three hundred square feet of liquid solar collectors will be constructed and mounted on frames adjacent to the building. Sixty square feet of additional collector area will be used for a domestic hot water preheating system. The grantee also plans to demonstrate a wind electric and photovoltaic electric system at the site in the future. A portion of this grant will be used to purchase educational materials for public use at the renewable energy library housed in the basement of the building.

RAE 182-CHRLS-771 — **Energy Use and Design Course for Contractors, Builders and Architects**

Grantee: **John Charles and**
Robert Warrington
Mechanical Engineering Department
Montana State University
Bozeman, MT 59717

Grant Amount: $12,006

Award date: 7-29-77

ABSTRACT:

A short course for contractors, builders and architects will be conducted and will focus on the design and construction of energy-efficient buildings which are suitable for both conventional and renewable energy heating sources. Taught by members of the Mechanical Engineering faculty at Montana State University, the course will cover: (1)the theory of energy, including its generation, usage, and concepts of efficiency; (2) evaluation of how current building practices affect energy use; (3) the possibility of improving energy efficiency in existing buildings; and (4) methods for estimating energy gain from passive solar features and relating these to building costs.

RAE 715-WRTN-781 — **Compile and Publish Handbook From Energy Use and Design Course**

Grantee: **Robert Warrington**
Mechanical Engineering Department
Montana State University
Bozeman, MT 59717

Grant Amount: $3,810

ABSTRACT:

This project will be to compile all materials used while conducting the Energy Use and Design course previously funded through the grants program, (See RAE 182-MSU-771), and publish it in an easy to read format for public use.

RAE 700-MCKIN-790 — **Summer Energy Institute for College and High School Teachers**

Grantee: **Lauren McKinsey**
Political Science Department
MSU
Bozeman, MT 59717

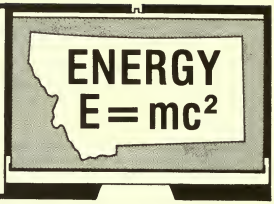
Grant Amount: $2,681

Award date: 6-7-79

ABSTRACT:

Attendees at the Institute will be exposed to a broad, interdisciplinary perspective on a selected number of energy policy issues which will focus on current U.S. energy policy and alternatives. The design of the Institute is to spur information exchange among college and high school teachers, especially in regard to strategies for research, reduction of energy demand in the classroom, potential for renewable energy and matching energy sources with appropriate end uses. Evaluation criteria will be developed in order to determine the effectiveness of the summer institute program and the grantee will require Montana participants to conduct programs of courses in their respective communities which are based on the knowledge derived from their attendence.

TECHNICAL ASSISTANCE



RAE 702-KLNGR-772 — **Study Legal and Institutional Barriers to Renewable Energy**

Grantee: **Richard Klinger**
619 First Street
Helena, MT 59601

Grant Amount: $10,000

Award date: 3-30-78

ABSTRACT:

The purpose of the project is to conduct a comprehensive study of existing and potential legal and institutional mechanisms which would stimulate the development and use of renewable energy. The study would include a review, inventory and analysis of existing laws, regulations, ordinances and incentive programs that bear upon aspects of encouraging the development and/or use of renewable energy sources. In addition, the study will include recommended modifications and/or additions to existing laws, regulations, ordinances and incentive programs, and will recommend other legislation which might facilitate increased research, demonstration and utilization of renewable energy resources.

RAE 782-MERDI-761 — **Center for Innovation**

Grantee: **Dr. Jerry Plunkett**
Montana Energy and MHD Research and Development Institute (MERDI)
P.O. Box 3809
Butte, MT 59701

Grant Amount: $107,500

Award date: 5-22-77

ABSTRACT:

This grant will help establish the Center for Innovation within the Montana Energy and MHD Research and Development Institute. CFI will be responsible for assisting the inventor/entrepreneur with developing, producing and marketing technology using renewable energy resources, as well as with securing federal, state, or private funds and other forms of institutional support for specific projects that show technical promise and economic development potential. The DNRC grant will be matched by $300,000 from the Economic Development Administration of the federal government and $400,000 from the Old West Regional Commission.

RAE 180-WEVER-771 — **Develop a Digitized Heat Control and Energy Monitoring System**

Grantee: **Donald Weaver**
2404 Spring Creek Drive
Bozeman, MT 59715

Grant Amount: $6,000

Award date: 7-11-77

ABSTRACT:

A low-cost digital heat control and monitoring system will be assembled and used to obtain data on all energy requirements of a conventionally heated home. The system will monitor and record the use of gas and electricity, temperatures both outside and at various inside locations, wind and solar radiation. The monitoring system will help reduce peak energy demands by indicating when parts of the house should be closed off and when supplemental heat should be used.

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